Transparency in the Food Chain

Edited by

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Food Quality and Safety

**Transparent_Food**

*Quality and integrity in food: a challenge for chain communication and transparency research*

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PREFACE

This book builds on material, which was carried out within the European project Transparent_Food (Quality and integrity in food: a challenge for chain communication and transparency research).

The project’s overall goal was to ‘contribute to the development of transparency in the sector by supporting understanding of its complexities, identifying the present state-of-the-art, learning from experiences, making stakeholders aware, specifying deficiencies and research needs, and formulating a research framework for facilitating future research initiatives’.

Transparency in the Food Chain is a fuzzy concept which involves many different domains, depends on views and expectations, and evolves dynamically in line with changing scenarios the food sector and society are confronted with, now and in the future.

With a broad range of definitions dealing with transparency in literature, this book builds on the understanding that transparency is being reached if everybody with stakes and interest in food production and consumption understands the relevant aspects of products, processes, and process environments and others that allow to making informed decisions.

From this definition as a base, the book moves towards an outline on how to make transparency work considering economic, social/ethical (integrity), or environmental aspects of sustainability for a core group with interest in transparency involving, consumers, policy, and industry. The focus is not on information content which is being dealt with in the project as such but on the integration of information into a transparency scheme. This discussion shows the complexity of issues to consider but also provides a clear sequence of issues that have to be dealt with.

Relevant issues reach from the development of tracking and tracing schemes, to a.o. activation schemes for information delivery, to data ownership, information sources, data carriers, the role of communication technology, or issues of organization and management.

The view is sector oriented, i.e. the discussion is not on the efforts by any individual enterprise but on how to provide support to the sector’s enterprises altogether and especially its SMEs to move forward in meeting transparency expectations.

A specific discussion scarcely dealt with in literature elaborates on the concepts of E-readiness and T-readiness as key concepts for reaching acceptance in the sector. E-readiness describes the sector’s ability and willingness to provide and utilize necessary information and communication technology, T-readiness the sector’s ability and willingness to provide and utilize the necessary information schemes. The analysis of these aspects is a pre-condition for linking transparency concepts with the sector’s reality.

Bonn, July 31, 2013

Gerhard Schiefer
Transparency in the Food Chain
# Table of content

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td>5</td>
</tr>
<tr>
<td>I INTRODUCTORY PART</td>
<td>19</td>
</tr>
<tr>
<td>II INFORMATION PART</td>
<td>45</td>
</tr>
<tr>
<td>A Food Safety</td>
<td>47</td>
</tr>
<tr>
<td>B Food Quality</td>
<td>82</td>
</tr>
<tr>
<td>C Food Chain Integrity</td>
<td>113</td>
</tr>
<tr>
<td>III COMMUNICATION</td>
<td>141</td>
</tr>
<tr>
<td>A Certification systems and labelling schemes signalling information to consumers</td>
<td>142</td>
</tr>
<tr>
<td>B Consumer requests, contexts for such requests and priorities</td>
<td>173</td>
</tr>
<tr>
<td>IV BEST PRACTICE</td>
<td>199</td>
</tr>
<tr>
<td>V CARRIERS OF TRANSPARENCY:</td>
<td>251</td>
</tr>
<tr>
<td>TOWARDS A EUROPEAN TRACKING AND TRACING BACKBONE</td>
<td></td>
</tr>
<tr>
<td>VI POLICY STATEMENTS AND LEGAL REQUIREMENTS</td>
<td>295</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>331</td>
</tr>
<tr>
<td>ACKNOWLEDGMENT</td>
<td>352</td>
</tr>
<tr>
<td>APPENDICES</td>
<td></td>
</tr>
<tr>
<td>Appendix 1: Authorlist and Consortium</td>
<td>353</td>
</tr>
<tr>
<td>Appendix 2: List of Regulations / Directive No.</td>
<td>357</td>
</tr>
<tr>
<td>Appendix 3: Table of stakeholders within the Part III</td>
<td>363</td>
</tr>
<tr>
<td>Appendix 4: List of certification schemes and their associate logos</td>
<td>365</td>
</tr>
</tbody>
</table>
# Detailed table of content

## I INTRODUCTORY PART

1 Introduction 20  
2 The transparency issue 21  
2.1 The focus 21  
2.2 The actors 24  
3 Approach 25  
3.1. Vertical communication view 26  
3.1.1 Technology and organization 28  
3.1.2 User groups 28  
3.1.3 Information collection 29  
3.2 Documentation approach 30  
3.3 Scope of analysis 33  
3.4 Proprietary rights on information 33  
4 Serving transparency needs 35  
4.1 Transparency domains 35  
4.2 Information collection for indicator specification 36  
4.3 Transformation 37  
5 Organizational system design 38  
6 Readiness 40  
7 Embedment into reality 42  
8 Summary 43
## Detailed table of content

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>II INFORMATION PART</td>
<td>45</td>
</tr>
<tr>
<td><strong>A FOOD SAFETY</strong></td>
<td>47</td>
</tr>
<tr>
<td>1 Introduction</td>
<td>48</td>
</tr>
<tr>
<td>2 Transparency in the Food Chain: Food safety, structure and signals</td>
<td>48</td>
</tr>
<tr>
<td>2.1 Primary production: animal line</td>
<td>49</td>
</tr>
<tr>
<td>2.2 Primary production: plant line</td>
<td>51</td>
</tr>
<tr>
<td>2.3 Processing: animal line</td>
<td>53</td>
</tr>
<tr>
<td>2.4 Processing: plant line</td>
<td>55</td>
</tr>
<tr>
<td>2.5 Retail, Food service and consumer</td>
<td>57</td>
</tr>
<tr>
<td>2.6 Generic safety issues and their communication through the chain</td>
<td>60</td>
</tr>
<tr>
<td>2.7 Transparency issues and barriers hindering transparency throughout the food production chain</td>
<td>62</td>
</tr>
<tr>
<td>2.8 Transparency domains relating to Food Safety</td>
<td>64</td>
</tr>
<tr>
<td>2.9 The need to improve transparency in the food chain with regard to food safety</td>
<td>66</td>
</tr>
<tr>
<td>3 Specification of critical research needs and priorities with relevance for food safety and quality concerns and for improvements in food chain transparency</td>
<td>68</td>
</tr>
<tr>
<td>3.1 Food chain complexity and emerging risks</td>
<td>68</td>
</tr>
<tr>
<td>3.2 Critical impact factors regarding food safety</td>
<td>68</td>
</tr>
<tr>
<td>3.3 Communication with consumers and society</td>
<td>70</td>
</tr>
<tr>
<td>3.4 Food processing technologies and food safety</td>
<td>71</td>
</tr>
<tr>
<td>3.5 Emerging technologies and Food safety</td>
<td>74</td>
</tr>
<tr>
<td>3.6 Food safety governance</td>
<td>76</td>
</tr>
<tr>
<td>3.7 Food in the parallel economy in the EU</td>
<td>78</td>
</tr>
<tr>
<td>4 Summary and conclusion</td>
<td>80</td>
</tr>
</tbody>
</table>
## Detailed table of content

### II INFORMATION PART

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B FOOD QUALITY</strong></td>
<td>82</td>
</tr>
<tr>
<td>1 Determination of food quality parameters of selected products</td>
<td></td>
</tr>
<tr>
<td>according to sensorial and nutritional quality definitions</td>
<td></td>
</tr>
<tr>
<td>1.1. Food quality</td>
<td>83</td>
</tr>
<tr>
<td>1.2 Impact factors on food quality</td>
<td>84</td>
</tr>
<tr>
<td>1.3 Food quality related domains of transparency</td>
<td>86</td>
</tr>
<tr>
<td>1.4 Summary</td>
<td>88</td>
</tr>
<tr>
<td>2 Analysis, evaluation, and documentation of selected ‘best practice’</td>
<td></td>
</tr>
<tr>
<td>monitoring and reporting schemes</td>
<td>89</td>
</tr>
<tr>
<td>2.1 RFID techniques for quality determination of harvested</td>
<td>90</td>
</tr>
<tr>
<td>perishable products</td>
<td></td>
</tr>
<tr>
<td>2.2 Fluorescens spectroscopy for quality determination of fresh pork</td>
<td>92</td>
</tr>
<tr>
<td>meat</td>
<td></td>
</tr>
<tr>
<td>2.3 Summary</td>
<td>93</td>
</tr>
<tr>
<td>3 Analysis of deficiencies (weaknesses) within traditional food</td>
<td></td>
</tr>
<tr>
<td>processing, of improvement opportunities through process optimization</td>
<td></td>
</tr>
<tr>
<td>or emerging technologies, and of feasibility regarding industrial</td>
<td>94</td>
</tr>
<tr>
<td>implementation</td>
<td></td>
</tr>
<tr>
<td>3.1 Overview of food processing technologies</td>
<td>94</td>
</tr>
<tr>
<td>3.2 Thermal processing</td>
<td>96</td>
</tr>
<tr>
<td>3.3 Non-thermal processing</td>
<td>97</td>
</tr>
<tr>
<td>3.4 Process assessment of non-thermal technologies and legislative</td>
<td>100</td>
</tr>
<tr>
<td>aspects</td>
<td></td>
</tr>
<tr>
<td>3.5 Summary</td>
<td>102</td>
</tr>
<tr>
<td>4 Specification of critical research needs and priorities with</td>
<td></td>
</tr>
<tr>
<td>relevance for food</td>
<td></td>
</tr>
<tr>
<td>safety and quality concerns and for improvements in food chain</td>
<td></td>
</tr>
<tr>
<td>transparency</td>
<td>103</td>
</tr>
<tr>
<td>4.1 Food chain complexity and emerging risks</td>
<td>104</td>
</tr>
<tr>
<td>4.2 Transfer of information and communication along the chain</td>
<td>105</td>
</tr>
<tr>
<td>4.3 Food quality standards</td>
<td>106</td>
</tr>
<tr>
<td>4.4 Communication with consumers/society</td>
<td>107</td>
</tr>
<tr>
<td>4.5 Analytical methods</td>
<td>108</td>
</tr>
<tr>
<td>4.6 Food Processing Technologies</td>
<td>109</td>
</tr>
<tr>
<td>4.7. Summary</td>
<td>111</td>
</tr>
<tr>
<td>5 Conclusions</td>
<td>111</td>
</tr>
</tbody>
</table>
## II INFORMATION PART

### C FOOD CHAIN INTEGRITY

1. Introduction 113

2. Environmental, Social and ethical concerns around food 114
   2.1 Environmental concerns about food 114
   2.2 Social and ethical concerns about food 115

3. Transparency and Integrity in the food chain 117

4. Assessing the state of the art of information use 119
   4.1 Selected schemes serving environmental transparency 123
   4.2 Selected schemes serving social and ethical transparency 124

5. Discussion 124
   5.1 Thematic observations 124
   5.2 Crosscutting observations on transparency 128
   5.3 Developing schemes for transparency of environmental, social and ethical concerns 130
   5.4 Providing verifiable, accessible and credible information 131

6. Need for further development 135
   6.1 Improved transfer of integrity characteristics within a chain 135
   6.2 Independent and integrated external assessment of integrity of food chains 138

7. Conclusion 139
# Detailed table of content

**III COMMUNICATION**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Certification systems and labelling schemes signalling information</td>
<td>142</td>
</tr>
<tr>
<td>to consumers</td>
<td></td>
</tr>
<tr>
<td><strong>1 Introduction</strong></td>
<td>143</td>
</tr>
<tr>
<td>1.1 Methodology</td>
<td>143</td>
</tr>
<tr>
<td>1.2 Signal Categories</td>
<td>143</td>
</tr>
<tr>
<td>1.3 Label and non-label based signals</td>
<td>145</td>
</tr>
<tr>
<td><strong>2 Stakeholder Perceptions</strong></td>
<td>151</td>
</tr>
<tr>
<td>2.1 Signalling to consumers: Keys constraints and considerations</td>
<td>151</td>
</tr>
<tr>
<td>2.2 Certification schemes: key strengths</td>
<td>152</td>
</tr>
<tr>
<td>2.2.1 Certification schemes: business-to-business and business-to-consume</td>
<td>152</td>
</tr>
<tr>
<td>2.2.2 The Utility of Certification schemes: meeting the goals of stakeholders</td>
<td>154</td>
</tr>
<tr>
<td>2.2.3 Reactive transparency: communicating beyond the logo</td>
<td>157</td>
</tr>
<tr>
<td>2.2.4 Stakeholder cooperation and signals</td>
<td>158</td>
</tr>
<tr>
<td>2.3 Weaknesses and challenges</td>
<td>159</td>
</tr>
<tr>
<td>2.3.1 Key challenges around specific signals</td>
<td>161</td>
</tr>
<tr>
<td>2.3.2 Food safety</td>
<td>162</td>
</tr>
<tr>
<td>2.3.3 Origin and provenance: responding to policy anomaly?</td>
<td>162</td>
</tr>
<tr>
<td>2.3.4 Environment and sustainability</td>
<td>162</td>
</tr>
<tr>
<td>2.3.5 Animal welfare</td>
<td>163</td>
</tr>
<tr>
<td><strong>3 Stakeholders and signal management</strong></td>
<td>165</td>
</tr>
<tr>
<td>3.1 Information-editing</td>
<td>165</td>
</tr>
<tr>
<td>3.2 ‘Guardian’ and ‘gatekeeper’</td>
<td>167</td>
</tr>
<tr>
<td><strong>4 Best practices alternatives</strong></td>
<td>169</td>
</tr>
<tr>
<td>4.1 Non-label provision of information</td>
<td>169</td>
</tr>
<tr>
<td>4.2 Future of transparency, signals and certification schemes</td>
<td>169</td>
</tr>
<tr>
<td><strong>5 Conclusions</strong></td>
<td>171</td>
</tr>
</tbody>
</table>
## Detailed table of content

### III COMMUNICATION

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B CONSUMER REQUESTS, CONTEXTS FOR SUCH REQUESTS AND PRIORITIES</strong></td>
<td>173</td>
</tr>
<tr>
<td>1 The aim</td>
<td>173</td>
</tr>
<tr>
<td>2 Defining and delineating</td>
<td>174</td>
</tr>
<tr>
<td>3 Information/Signals (label/non-label ones) of transparency</td>
<td>175</td>
</tr>
<tr>
<td>3.1 Brands</td>
<td>175</td>
</tr>
<tr>
<td>3.2 Information/Signals (label/non-label)</td>
<td>176</td>
</tr>
<tr>
<td>3.3 Use of information/signals: Distortions, complexities and imperfections</td>
<td>179</td>
</tr>
<tr>
<td>4 Alternative viewpoints</td>
<td>180</td>
</tr>
<tr>
<td>5 Transparency regarding information/signals –A meta-analytic framework and its basic tenants</td>
<td>185</td>
</tr>
<tr>
<td>6 The moderating influence of trust and consumer perception of firm/supply chain motives and willingness to disclose information</td>
<td>192</td>
</tr>
<tr>
<td>7 Barriers of transparency</td>
<td>194</td>
</tr>
<tr>
<td>8 Interfacing with information transmission standards, technologies and information carriers</td>
<td>195</td>
</tr>
</tbody>
</table>
## Detailed table of content

<table>
<thead>
<tr>
<th>IV BEST PRACTICE</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Introduction</td>
<td>100</td>
</tr>
<tr>
<td>4.2 Methodology</td>
<td>101</td>
</tr>
<tr>
<td>4.3 Transparency domains</td>
<td>202</td>
</tr>
<tr>
<td>4.4 Good Practices</td>
<td>203</td>
</tr>
<tr>
<td>4.5 Recommended sub-domain specific transparency practices</td>
<td>233</td>
</tr>
<tr>
<td>4.6 Conclusions</td>
<td>248</td>
</tr>
</tbody>
</table>
## Detailed table of content

**V CARRIERS OF TRANSPARENCY: TOWARDS A EUROPEAN TRACKING AND TRACING BACKBONE**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Introduction</strong></td>
<td>252</td>
</tr>
<tr>
<td><strong>2 Requirements Analysis</strong></td>
<td>254</td>
</tr>
<tr>
<td>2.1 Sector Structure</td>
<td>254</td>
</tr>
<tr>
<td>2.2 Stakeholder Expectations</td>
<td>256</td>
</tr>
<tr>
<td>2.3 Food Properties and Handling</td>
<td>257</td>
</tr>
<tr>
<td>2.4 Existing Tracking and Tracing Systems</td>
<td>259</td>
</tr>
<tr>
<td><strong>3 Tracking and Tracing Backbone Feasibility</strong></td>
<td>263</td>
</tr>
<tr>
<td>3.1 Organisational Resources</td>
<td>263</td>
</tr>
<tr>
<td>3.2 Protocol</td>
<td>265</td>
</tr>
<tr>
<td>3.3 Syntax</td>
<td>267</td>
</tr>
<tr>
<td>3.4 Semantics</td>
<td>269</td>
</tr>
<tr>
<td>3.5 Identification</td>
<td>272</td>
</tr>
<tr>
<td>3.6 State-of-the-Art in other Industries</td>
<td>276</td>
</tr>
<tr>
<td>3.6.1 Product Identification in the Pharmaceutical Sector</td>
<td>276</td>
</tr>
<tr>
<td>3.6.2 Electronic Record Procedure for Waste in Germany</td>
<td>277</td>
</tr>
<tr>
<td><strong>4 Tracking and Tracing Backbone Solution Blueprint Proposal</strong></td>
<td>278</td>
</tr>
<tr>
<td>4.1 Architecture</td>
<td>278</td>
</tr>
<tr>
<td>4.2 Labelling and Identification</td>
<td>280</td>
</tr>
<tr>
<td>4.3 Data Model</td>
<td>281</td>
</tr>
<tr>
<td>4.4 Syntax</td>
<td>283</td>
</tr>
<tr>
<td>4.5 Semantics</td>
<td>284</td>
</tr>
<tr>
<td>4.6 Protocol</td>
<td>285</td>
</tr>
<tr>
<td>4.7 Example Scenario: Transparency along the Entire Chicken Chain</td>
<td>286</td>
</tr>
<tr>
<td><strong>5 Conclusions</strong></td>
<td>290</td>
</tr>
</tbody>
</table>
## Detailed table of content

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VI POLICY STATEMENTS AND LEGAL REQUIREMENTS</strong></td>
<td>297</td>
</tr>
<tr>
<td>1. Introduction</td>
<td></td>
</tr>
<tr>
<td>1.1 Definition of labels and logos</td>
<td>297</td>
</tr>
<tr>
<td>1.2 Distinction between mandatory and voluntary</td>
<td>298</td>
</tr>
<tr>
<td>1.2.1 Labelling regulation: Directive 2000/13/EC</td>
<td>298</td>
</tr>
<tr>
<td>1.2.2 Marketing standards</td>
<td>298</td>
</tr>
<tr>
<td>1.3 DG Sanco perspective on labelling</td>
<td>299</td>
</tr>
<tr>
<td>1.4 EU Commission: informing consumers about agricultural product quality</td>
<td>299</td>
</tr>
<tr>
<td>1.5 Information sources for this chapter</td>
<td>299</td>
</tr>
<tr>
<td>2 Food Safety and Food Quality (composition)</td>
<td></td>
</tr>
<tr>
<td>2.1 Mandatory information: Directive 2000/13/EC</td>
<td>300</td>
</tr>
<tr>
<td>2.2 Food additives, food sweeteners and food colouring</td>
<td>301</td>
</tr>
<tr>
<td>2.3 Allergens: Directive 2007/68/EC</td>
<td>302</td>
</tr>
<tr>
<td>2.4 Food safety: Regulation (EC) 178/2002</td>
<td>303</td>
</tr>
<tr>
<td>2.5 Traceability: Regulation (EC) 178/2002</td>
<td>303</td>
</tr>
<tr>
<td>2.6 Beef: Regulation (EC) No 1760/2000 and Ovine and caprine animals:</td>
<td></td>
</tr>
<tr>
<td>Regulation (EC) 21/2004</td>
<td>304</td>
</tr>
<tr>
<td>2.7 Summary</td>
<td>304</td>
</tr>
<tr>
<td>3 Food Quality (nutrition and health claims)</td>
<td></td>
</tr>
<tr>
<td>3.1 Health claims: EC Regulation No 1924/2006</td>
<td>305</td>
</tr>
<tr>
<td>3.2 Nutrition content: Directive 90/496/EEC</td>
<td>306</td>
</tr>
<tr>
<td>3.2.1 Nutrition content: proposal for a regulation on the provision of food information</td>
<td>306</td>
</tr>
<tr>
<td>3.2.2 Policy aims and objectives</td>
<td>307</td>
</tr>
<tr>
<td>3.2.3 Presentation of information on food labels</td>
<td>307</td>
</tr>
<tr>
<td>3.3 Summary</td>
<td>308</td>
</tr>
<tr>
<td>4 Food Quality (marketing standards)</td>
<td>308</td>
</tr>
<tr>
<td>5 Food Quality (agricultural produce)</td>
<td>3079</td>
</tr>
<tr>
<td>6 Origin (referring to place, region and country)</td>
<td></td>
</tr>
<tr>
<td>6.1 Protected Designation of Origin (PDos), Protected Geographical Indicator (PGIs) and Traditional Speciality Guaranteed (TSGs)</td>
<td>310</td>
</tr>
<tr>
<td>6.1.1 Policy aim of PDos, PGIs and TSGs</td>
<td>311</td>
</tr>
<tr>
<td>6.1.2 Impact assessment of PDO schemes</td>
<td>311</td>
</tr>
<tr>
<td>6.2 Non-scheme based country of origin labelling</td>
<td>312</td>
</tr>
<tr>
<td>6.3 Summary</td>
<td>313</td>
</tr>
</tbody>
</table>
I INTRODUCTORY PART

Prepared by:

<table>
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1 Earlier version published as deliverables within the EU project Transparent_Food:
   D7.1 Framework for analysis, documentation and evaluation
   D7.2 Focus guide on transparency, tracking, tracing, sustainability and integrity
1 Introduction

Dealing with the analysis of food chains and networks is a challenge. It has been called a wicked problem because of the many different dimensions that determine the sustainable success of food chains and networks not the least their acceptance by markets, consumers and the society represented by the regulatory framework the food sector has to deal with.

**Transparency** in the food chain is an old requirement brought forward by consumers but also by industry which depends on transparency in its own decision processes in logistics and marketing. Management approaches like *Efficient Consumer Response* (ECR) or *Customer Relationship Management* (CRM) have transparency as an implicit goal. However, because of their focus on the end of the chain they have missed to integrate the chain and network view as a whole and the need to build transparency on the participation of all actors in the field, consumers, enterprises, institutions, households, and agriculture as the common production base. The global activities of chains and networks and the global sourcing involving agriculture from different countries, continents, and cultural backgrounds have contributed to the transparency challenge.

The food sector is by large characterized by a network of enterprises with dynamically evolving trade relationships. In the production of food, the network develops into a **food value chain** which reaches from supply industry to agriculture, processing industry and trade until retail which serves the consumer as the ultimate customer of the system (figure 1).

The food value chain is dominated by globally active enterprises (or enterprise groups) at its ends, the supply industry and retail, while the economic actors in-between are pre-dominantly SMEs with limited cooperation between them. This applies not only to agriculture but processing industry as well where SMEs account for more than 90% of actors.

The complexity of the network is further characterized by its **global orientation**. The sourcing of products in today’s diets requires global activities involving many countries and cultural backgrounds.

![Figure 1: Food system network.](image-url)
All these and other elements combined have contributed to deficiencies in transparency on the origin of products and on production activities with chain participants, consumers and policy as representative of society.

This is the basis for this book which formulates as its **general objectives**, to “**contribute to the development of transparency in the sector by supporting understanding of its complexities, identifying the present state-of-the-art, learning from experiences, making stakeholders aware, specifying deficiencies and research needs, and formulating a research framework for facilitating future research initiatives**”.

The general objective is captured in the following four concrete and **verifiable project objectives**:

1. Identification (analysis) of the state-of-the art on transparency knowledge and understanding.
2. Identification (analysis) of deficiencies in stakeholder transparency and needs for future research initiatives.
3. Providing transparency uptake support.
4. Developing transparency awareness.

There are groups representing major brands in the sector which might build on closely controlled chain activities where transparency is not an issue and communication between actors has been organized according to needs. However, these well organized groups do not represent the majority of the network, leaving most of the sector with transparency deficiencies.

### 2 The transparency issue

#### 2.1 The focus

Transparency is one of the issues which, from the outset, seem to be very easy to understand resulting in proposals abound. Various disciplines reaching from linguistics to macroeconomics or financial and operational management have provided definitions.

The differences are usually due to differences in focus. In industrial marketing, a definition with focus on ‘supplier-buyer relationships’, understands transparency as an individual’s *subjective* perception of *being informed* about the relevant actions and properties of the other party in the interaction (Eggert and Helm, 2003). In Operations Management with a focus on process organization, process transparency is reached if everyone *can see and understand* the necessary aspects and status of an operation at all times (Womack and Jones, 2003).

These views capture the opposite ends in the range of interpretations. The first one expresses a *subjective perception* of being informed, the second one expresses (an objective) *understanding* supported by (visual) guarantees (‘can see’). In efforts towards the realization of transparency, both alternatives might be part of developments:
1. The alternatives could be viewed as being part of a development process where transparency requests are first served as expected and subsequently by providing knowledge that supports understanding.

2. The alternatives could be viewed as representing the differing views of providers and recipients of transparency. Providers could minimize efforts by following the first alternative (serving subjective perception) while recipients would be interested in the second one (support of understanding).

The difference between ‘subjective perception’ and ‘understanding’ is especially relevant in complex situations where information that is provided meets actual perceptions already in place (e.g., Canavari et al., 2010). In complex environments, expectations towards transparency might mean something different to different actors and individuals. It is one of the challenges to provide information that leads to objectivity irrespective of focus, situation and background of recipients. This is not easy to grasp in a situation where recipients assume to have transparency.

However, irrespective of difficulties, goals towards providing transparency to actors in the value chain will have to eventually focus on reaching a level of understanding which allows ‘informed decisions’ on an objective basis. This is a crucial prerequisite for reaching a transparency view which is sustainable in the long run. In summary we could specify the transparency challenge in the food sector as follows:

Transparency is being reached if everybody with stakes and interest in food production and consumption understands the relevant aspects of products, processes, and process environments that allow to making informed decisions.

The challenge is to provide the information that enables consumers and other decision makers to reach this status from their present knowledge and perceptions. The provision of information could involve a broad range of alternatives depending on opportunities but also on the ability and willingness of consumers and decision makers to grasp, interpret, and process the information as needed (e.g., Qudrat-Ullah et al., 2008). Common examples involve data (e.g. about the content of substances), data aggregates (e.g. an index), signals or messages. The delivery of the ‘right’ information is further aggravated by the food sector’s complexity (e.g., Deimel et al., 2008). In this complex environment there is no feasible approach to deliver the perfectly right information to everybody in all possible scenarios.

In this chapter the focus is therefore on the delineation of categories that allow to best serving transparency needs within limits set by available resources. Such categories could relate to products, processes, information, or actors identifying groups that could be dealt with in a homogenous way. It evident that increased divergence in products, processes, information or actors increases the need for differentiation in serving transparency needs.

The identification of the appropriate (optimal) level of differentiation is due to an analysis of costs and benefits. However, this is tricky as the results of the analysis might (and usually do) differ
between providers and recipients of transparency. This discrepancy is part of the ongoing discussion on transparency in the food sector. The difficulty is further aggravated as the perception of costs and benefits is not just a monetary issue but involves non-monetary elements whose value to actors might change over time. As an example, consumers’ interest in transparency might involve animal welfare or climatic issues which were of less relevance in the past (Barling et al., 2009).

Figure 2 shows the relationship between the costs of provision of information and the transparency quality provided to the recipient. A certain level of differentiation or transparency delivered to recipients (expressed as X on the horizontal axis) builds on a certain level of costs for information provision (C) but still leaves certain deficiencies with recipients (T). It is obvious that an increase in quality (e.g. through a further differentiation of information) is connected with higher costs. However, it is also obvious that developments in technology might lower costs (through e.g. lower network costs which would lower the cost curve as expressed by arrow 2). An increase in transparency needs (e.g. through interest in additional domains which would move the transparency curve upwards as expressed by arrow 1) would increase costs as well (upwards move of cost curve). However, this increase could be offset by new technology which lowered costs (downwards move of cost curve, arrow 2). The triangle between transparency delivery, technology and costs determines the monetary considerations in investment decisions by enterprises.

The developments in technology that are viewed at in this discussion are characterized by (see also Jedermann et al., 2006; Ngai et al., 2008; Regattieri et al., 2007)

a) improved sensor technology for data collection,

b) improved RFID technology for communication,

c) improved scanner technology for information reception, and

d) improved communication networks for online monitoring of products and their movements.
As is known from the past and supported by discussions on future technology scenarios, such developments combine the provision of improved capability with lower costs.

### 2.2 The actors
Food networks involve many different actors with interest in transparency activities involving consumers but also employees, institutions for food safety control, communities and many others (Fritz and Schiefer, 2008).

However, in this book we concentrate on core groups, including

- a) consumers as the ultimate customers in the chain,
- b) policy and related institutions that represent society’s interests, and
- c) enterprises along the value chain that are responsible for providing the food to consumers.

These actors (as others) are linked with transparency initiatives as recipients but also as providers of information for transparency. The focus in this book is on transparency serving the needs of recipients but also on clarifying the involvement of others within the core group for making transparency a reality.

The prime interest in our discussion is with **consumers** who are the ultimate customers of the food network and the cause for its existence. It is evident that the principal *transparency interest* of consumers is on the products they consume, their safety, quality, availability and affordability (Fritz and Schiefer, 2008). However, beyond these basic requirements consumers may show interest in issues not directly related to products but derived from their (the consumers’) value system involving, e.g., requirements on origins, process organization, environmental protection or social responsibility (Lobb et al., 2007). For the fulfilment of transparency needs, consumers are dependent on industry which could provide the necessary information as well as on policy which could deliver guarantees through its controls.

**Policy** interests deal with both, interests of consumers (assuring, e.g., the safety of food) and society (assuring, e.g., that social standards are being kept). It provides the legislative space in which industry can act and provides guidance (e.g. through its tax and subsidy policy) on the direction of developments. Its *transparency needs* derive from the domains it is active in. In principle, policy is in a comfortable position regarding the fulfilment of its transparency needs. It can enforce the fulfilment by industry and other actors through booking requirements and government controls. In addition, it can support the fulfilment of transparency needs of consumers or industry through legislative or guiding initiatives.

**Industry** follows its objectives within the boundaries set by legislation and the value system of society, enforced by market reactions on its activities. In general, the long-term focus of enterprises is on improving market position and internal strengths (e.g., Porter, 1980; Barney, 1991). In this
regard, core transparency needs refer to suppliers and their products (input), to customers including consumers with their attitudes (taking up outputs), and to the market environment (legal, cultural, natural, social, political, etc.) the enterprise is in or intends to be. Industry depends on the provision of information through its suppliers, its customers (e.g. through retail on market requirements), and through research regarding consumer attitudes and market environment (strategic view).

Table 1

Primary interactions for transparency among the core interest group

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The principle interaction between the core group members is summarized in table 1. For reaching transparency, the major interaction is within industry (for communication along the value chain) and between industry (as suppliers of products) and consumers.

3 Approach

For its analysis, the project utilized a broad range of approaches, including literature analysis, best practice analysis, chain analysis, work group discussions, expert discussions, surveys, web consultations, and simulation studies to reach results that serve the objectives.

In the discussion we distinguish between

a) the view of the analysis and

b) the documentation of results which could provide the basis for future transparency research.

The view of the analysis will utilize a ‘layer approach’ that accounts for the complexity in transparency discussions. It distinguishes between
a) lower levels linked to the actors in the food value chain and their production and distribution processes and

b) upper levels linked to the recipients of transparency (figure 3).

The different layers identify different communication needs. One needs to be aware that all layers build on a total chain view reaching from the source of production to the consumer as the final customer. In the organization of transparency schemes, the drivers for the identification of its content are, first, the needs of the ultimate stakeholders (consumers and policy), and secondly, the follow-up needs of enterprises for supporting them in serving markets and dealing with regulatory environments. However, the actual organization of the scheme is being built from the bottom, from raw data to be collected at the source towards the provision of the appropriate signals to stakeholders.

Figure 3: The multi-layer analysis concept

In the chain analysis, this multi-layer approach needs to be transferred into the total chain view where the collection of information, the preparation of signals, and the communication of signals depend on each other and are usually linked to different time periods and to different stages in the food value chain. This vertical communication view also provides the basis for the documentation of the state-of-the-art in transparency needs, deliveries and remaining gaps.

3.1 Vertical communication view

The principal vertical communication view used within the project is described in figure 3. The interest of transparency recipients is on domains that characterize issues of sustainability, all of them derived from the three principal pillars of today’s understanding of sustainability dealing with
economic, environmental, and social/ethical issues. Each one of these pillars involves a cluster of more focused domains like ‘global warming’, animal welfare, food safety, food quality, institutional arrangements, etc. Transparency on the domains is reached through signals which build on indicators served by information items.

As an example, the organization of certain production processes (= information) may have an effect on carbon emissions captured in an indicator ‘carbon footprint’ which may be an element in a compound environmental signal with relevance for the global warming domain.

![Diagram](image)

**Figure 4:** The information flow in the chain view.

The linkage between information, indicators, signals, and domains might differ as demonstrated in the figure. While the typical development is from information to indicators, to signals, and to domains, certain information items might take the role of indicators and signals without any change. A typical example is the information about product travel distances captured in miles (‘food miles’) which could act as a signal without any change in content or format.

The framework captured in figure 4 builds on the assumptions

a) that different levels of **technology** and **organizational development** will allow, in principle, to serve different levels of transparency,

b) that the **needs for transparency** might differ not only between different user groups (consumers, policy) but between different cultural backgrounds, and

c) that information may be captured from different **sources and stages** with different requirements on its move towards the final users’ stage.
3.1.1 Technology and organization

It is evident that different levels of sensor, process, and communication technology have a direct effect on the value chain’s capability of providing information for serving different transparency needs. As there are many variations in technology and technology combinations, the project had to capture these differences through a specification of a limited number of technology levels. A first working approach could focus on three levels defined as

a) **present level** representing a common state-of-the-art,

b) **advanced level** at the forefront of developments (time frame about 5 years), and

c) **future level** with a time frame of about 10-20 years.

It is known from various sources that technology developments might have major effects on transparency potentials but also on reducing adoption barriers. In other words, technology developments might eliminate some of the barriers we today might have to deal with in discussing transparency improvements. As an example (www.cuteloop.eu), in assuring tracking and tracing capability, today’s communication technology might require organizational and managerial communication infrastructures within the sector which might be difficult to reach. Future technology based on network devices like sophisticated RFIDs might allow approaches were products are packaged with intelligent RFIDs with sensor, storage, processing and communication ability which allowed products to carry all necessary information, to monitor themselves and to communicate with users as requested, e.g., to care for transparency themselves (self-contained units). In discussing actual barriers towards improvements in transparency and in formulating research requirements such potential developments need to be accounted for.

Organizational developments such as the level of horizontal cooperation among e.g. farms or institutional sector agreements, on the management of communication, complement developments in technology. Different levels of organizational development will be attached to the pre-defined technology levels to not increase the number of sector alternatives to be distinguished in the transparency discussions.

3.1.2 User groups

It is well established knowledge that transparency needs are not uniform across user groups and cultural backgrounds. This refers to a.o. the focus (or priorities) of interest as well as the communication approach. Furthermore, transparency needs might change over time depending on developments in scenarios and awareness. The project could capture these differences by attaching different priority vectors to

a) a (generic) list of potential domains of interest as well as to
b) alternatives in signal communication.

To cope with the complexity of user differences, the project needed to categorize user groups and focus on a limited number of categories. The limitation could either build on limitations in the number of categories distinguished, on the selection of priority categories, or on both.

### 3.1.3 Information collection

Information captured at any stage might be derived from technical or organizational processes within that stage, from characteristics of that stage or from characteristics of the environment (figure 5). Examples of stage characteristics might be the identification of the actor involved (e.g. ‘origin’, trustworthiness, certification, social behavior). Examples of environmental characteristics might involve information on the natural environment, the legal system (social laws) or the country’s food control system.

![Figure 5: Principal information sources](image)

The many different sources have an impact on information collection and communication requirements. Regarding information collection, one can distinguish between three principal alternatives with decreasing collection intensity. An appropriate information collection scheme would be one with a fitting level of collection intensity:

1. Information might refer to **changing conditions** at relevant information sources. Examples might refer to process parameters which require *regular* or frequent monitoring activity.

2. Information might refer to **repetitive procedures** or stable **organizational set-ups**. This information could be captured in a document like a *certificate* as is common in quality management situations.
3. Information might refer to **standard procedures** or a **common scenario**. Examples might include standardized technical production processes where inputs and outputs are well known or the situational conditions in the home country. In both cases one could build on **reference data** (standardized data) available in data bases for general use.

Differences in communication schemes refer to the transformation of information during communication activities. We consider two principal alternatives:

1. When passing subsequent stages, information might remain unchanged, aggregated, reduced or complemented by information from subsequent stages (figure 6).

![Figure 6: Information transformation in communication processes](image)

2. During the communication process, information might be processed into indicators and/or signals either directly or after being complemented by additional information from the originating or subsequent stages (figure 7).

![Figure 7: The link between information and signals](image)

**3.2 Documentation approach**
The basic documentation of information flows is through **tables** that capture (for the distinguished levels of technology) content, source, transformation approach, signal relevance and focus domain.
An example of a table has been described earlier (figure 8). However, there is no pre-defined table approach at this point. The key interest is to capture the relationships.

![Diagram](image)

Figure 8: Example of documentation alternative

A similar situation refers to the graphical presentation of the results. A number of alternatives have been developed at University of Bonn utilizing experiences in information system design and evaluation form other projects. They build on elements from UML and other proposals for information documentation.

Some examples are presented here. The example does not involve any specific content for the transparency project but is presented for demonstration purposes only. The example demonstrates a very high level of aggregation which would have to be complemented by lower level descriptions.

Figure 9 presents an example with information clusters that are available at different stages of the value chain (e.g. the quality level of feed at the feed production stage) for serving possible quality related transparency needs at the end of the value chain.

![Diagram](image)

Figure 9: Available information clusters at different stages of the chain (example).
Transparency in the Food Chain

Figure 10 displays the information clusters that would be needed for serving quality related transparency needs at the end of the value chain.

Figure 10: Information requirements for serving transparency needs.

From comparisons of information clusters that are available in a certain scenario and the information clusters that would be needed for serving quality related transparency needs one could specify the gaps that would require further attention (figure 11).

Figure 11: Information gaps
(distinguished as ‘information gap’, ‘preparation/processing gap’, ‘communication gap’).

The display communicates that there is no gap in information collection but in the preparation of information for use (stage: slaughter) and in the communication towards retail.

A more complex example dealing with the gaps in environmental transparency is shown in figure 12.
Transparency in the Food Chain

The linkage of the gaps with potential information systems that could eliminate the gaps is being demonstrated in the example of figure 13. Of course, the information system units specified in the figure involve further specifications on content which would have to be clarified on a more detailed level of documentation. All the documentation alternatives discussed here are just for demonstration purposes and might not be used in the final project results. They provide some ideas on what and how to communicate.

3.3 Scope of analysis
The analysis of the state-of-the-art and of research needs in transparency development have to build on a specification of the scope to reach results within the limited time frame of the project. For the first stage, the analysis of the state-of-the-art, the project could follow two principal alternatives:

1. Identify lead products within each product category (cereals, pork, meat, vegetables, etc.).
2. Cover the whole range of all products.

The project followed the first approach in its analysis and might follow the second approach in the aggregation of results. The decision to initially follow the first approach builds on the insight that it is initially not yet clear where to expect what. The project therefore followed an approach commonly referred to in the management domain as ‘environmental scanning’.

3.4 Proprietary rights on information
One of the key issues in the development of transparency concerns the ownership of data. For enterprises, the ownership on certain data might be linked with competitive advantages in the market.
They might be willing to share these data

a) in case of problems (e.g. in food safety) that require action or

b) if they received an appropriate share from the market advantages others (e.g. retail) might be able to materialize due to increases in transparency.

Based on these arguments, the project looked into different options for ‘activating’ transparency. Such a differentiation could involve transparency based on information received

a) on a regular basis,

b) on demand, or

c) as exception reporting.

Both, information on demand and information as exception reporting, would build on certain rules that specify conditions (e.g. apparent product quality deficiencies etc.) in which they could be realized.
4 Serving transparency needs

4.1 Transparency domains

Transparency is served through the provision of information of whatever kind on products, processes and other domains of interest to the user. For linking the collection of information on one side and its use in chain environments with several stages on the other side, the approach of Life Cycle Assessment (LCA, ISO14040:2006) has gained prominence. Without going into details, it builds on relationships that link

a) inputs and outputs of processes with

b) indicators with

c) impact domains of interest, and with

d) signals that communicate the relevance of process inputs and outputs for impact domains towards information recipients.

Initially developed for environmental analysis (Mattson and Sonesson, 2003), LCA has been extended to serve all kinds of domains, including e.g. economic (e.g., Kicherer et al., 2007) or social ones (e.g., Geibler et al., 2006). The domains are usually linked to one of the major pillars of sustainability, focussing on economic, social and environmental issues.

The cluster of impact domains that is being discussed in society is quite stable and has even been the focus of standardization efforts. What is subject to changes is

a) the vector of relative importance attached to the domains in different scenarios and

b) the vector’s adjustment to changes in society’s value system over time.

From this point of view, discussions on transparency would have to look at

a) the cluster of domains agreed upon,

b) the vectors of relative importance differentiated according to sectors and cultural environments, and

c) the expected changes of vectors over time.

This analysis provides a picture on transparency priorities and their changes over time.
Impact domains could be served by different indicators and indicators could serve different impact domains. Similarly, effects on impact domains could be expressed by different signals and signals could express effects on different impact domains.

The difference between indicators and signals is not always apparent. Indicators serve impact domains, signals serve transparency needs. As an example, CO2 emissions might serve as an indicator for impacts on climatic change, food miles are a signal towards consumers regarding the quantity of CO2 emissions (Pretty et al., 2005; DEFRA, 2005; Blanke and Burdick, 2005) that impact climatic change. On the other hand, information on the origin of products or the retail outlet the product is being sold through might be considered indicators for impacts on quality but could serve as quality signals towards consumers as well.

When looking at indicators and signals one has to consider two lines of variability. First, the clusters of identified indicators and signals that could be linked to impact domains might change. New developments in technology and science or changes in people’s perception etc. might bring up new indicators and signals not considered before. Secondly, in situations with a multiple relationship between indicators and domains or between domains and signals the relationships could be captured in vectors of relative importance which, as in the case of domains, might show differences according to e.g. production systems, sectors or cultural environments and be subject to changes over time.

To account for this variability, any system approach for delivering transparency would have to build as much as possible on generic communication approaches (building on categorization approaches) where any specific indicator or signal could be replaced by one from the same category (building on the same generic communication approach) with limited efforts.

4.2 Information collection for indicator specification
The collection of information and its communication is the most crucial prerequisite for reaching transparency. For the identification of appropriate information collection schemes, one of the aspects to consider is the stability of information.

1. Variable information. This is information that might continuously change (and within a range that might be of relevance for transparency. This type of information is common in production processes where quality characteristics and contamination of products (pesticides, etc.) need to be monitored on a continuous basis. Such monitoring schemes could build on a vertical approach (process monitoring) or on a horizontal approach where enterprises participate in joint monitoring scheme (as e.g. in salmonella monitoring).

2. Semi-stable information. This type of information characterizes production scenarios that do not continuously change. Examples involve the implementation of production processes, the
establishment of production controls, or the prevalent working conditions etc. Such production conditions can be captured through audits that follow a certain time sequence (e.g. 1 year) as is common in certification schemes. Examples include schemes dealing with quality (e.g. ISO 9000, HACCP, IFS or BRC), environmental (e.g. ISO 14001) or social (e.g. fair trade) issues.

3. Stable information. This type of information is considered to be valid for any specific production scenario either perfectly or within an accepted variability. Examples include quality characteristics of specified products produced through a specified production process within a specified production environment. Such information could be collected once and be made available in standard data bases for use where needed. Actual initiatives involve the specification of ‘CO2 emissions’ or ‘food miles’ that could be allocated to product groups (e.g. apples produced in certain regions).

From an economic point of view and in support of the feasibility of transparency efforts, producers and industry as primary information providers would need to move as much information needs as possible to the status of ‘stable or semi-stable’. A suitable categorization of information needs along these lines is a challenge which could greatly facilitate the development of transparency schemes.

Apart from this categorization of information, a transparency system suitable for realization requires a built-in flexibility in the relationships between information, indicators, and signal:

1. The relationships need to involve buffers which assure that variations of an input variable (e.g. indicator) within certain limits do not affect the output variable (e.g. signal). This requires an identification of the variability ranges.

2. The relationships should allow a certain change in input variables that could serve output variables. This flexibility would facilitate the systems’ adaptation to changing conditions and scenarios.

4.3 Transformation
Considering the many product lines in the food sector, including meat, fish, fruits and vegetables, or cereals the identification of product specific information sources and their linkage with appropriate indicators and signals might involve a tremendous task. However, it is argued that signals that serve transparency needs of consumers and policy do not differ substantially between product lines (e.g. the concept of ‘food miles’ is product independent), that there is a common base of approaches for information generation (e.g. through certain controls), and that there is a certain overlap in information sources (e.g. certification schemes) utilized in different product lines.
This hypothesis allowed the formulation of signal-information trees that cut across different product lines.

In linking information with indicators and signals, there is a great variety of alternatives that guide the transformation of information on its way through the value chain. As examples, information on the consideration of animal welfare at farm level might be communicated without changes and, in effect, could bypass customer enterprises while information on ‘food miles’ would be dependent on individual enterprise activities all along the chain. Life Cycle Assessment (LCA) and its variations like Social-LCA etc. have been dealing with those issues and provide suggestions for suitable transformation activities.

However, without referring to some of the more complex transformation needs there is already a multitude of information in the value chain that might be suitable for the formulation of indicators and signals but is rarely tapped in today’s communication schemes.

This is illustrated through two examples. Information about GlobalGAP certification of farms involves, in principle, a lot of detailed information about production processes, environmental concerns etc. that is scarcely utilized at retail stage. Furthermore, chain focused quality systems like the systems Q&S (DE) or IKB (NL) build on certification of stage specific fulfilments of requirements. Knowledge on the certification of supplier enterprises could provide, in principle, a multitude of information details concerning products, processes, controls, and management of supplier enterprises that is scarcely used but could support end-of-chain transparency signals.

5 Organizational system design

The provision of transparency in a sector environment depends not only on the specification and availability of appropriate information and communication schemes but also on the existence of an appropriate organizational infrastructure that

a) provides the managerial and technical basis,

b) provides the political platform for reaching sector agreements,

c) organizes the appropriate information flows,

d) protects data ownership interests, and

e) provides guarantees for data reliability and system security.
The combination of ‘content’ and ‘organization’ is the prerequisite for reaching transparency in a sector environment. A critical issue is data ownership, especially on the farm level. Data ownership is closely related to the way information might be provided for use in the chain which could be built on continuous provision, provision on demand (query), or through exception reporting. With respect to data ownership, the provision of information on demand is less sensitive than continuous information delivery. Guarantees for data reliability might require the communication of additional information on, e.g. the reliability of the sender (enterprise) through information on certification etc. With the diversity of the sector and countries involved, the organizational infrastructure cannot follow a universal concept but will need to build on many different clusters and solutions. Integration would need to build on the capability for interactions on the basis of generally agreed exchange standards.

In the documentation of transparency systems one needs to distinguish a number of phases. They involve

a) the collection of information,

b) the processing of information,

c) the communication of information, and

d) the utilization of information.

It has been demonstrated (www.cuteloop.org) that these phases can be adequately represented by a few generic functionalities with ‘information filters’ and ‘action triggers’ at the core. Filters and triggers are rule-based system elements. The specification of rules identifies the characteristics of any transparency system. One could distinguish generic rules, sector specific rules and application specific rules. Examples of generic rules involve the consideration of limits in content (as, e.g., limits on pesticides) and the identification of products with certain characteristics (as, e.g., GMOS). The combination of these core functionalities with input, output and communication functionalities and their organization into generic sequences of functionalities allows a sufficient description of information flows embedded in transparency systems.

The combination of functionalities with technology elements as e.g. RFIDs (Ngai et al., 2008) or scanners of any level of sophistication determines the principal capability (quality) and efficiency of transparency systems. As a consequence, certain requirements on the capability of transparency systems might require the implementation of a certain level of technology or, in other words, developments in technology support development paths towards higher levels of transparency.
To sum it up, the quality of a transparency system is a function of needs, ability and willingness to provide transparency, and the level of technology available for its support. If we take transparency needs in a certain scenario as granted, the potential for delivery is characterized by

a) the ability and willingness of information providers to utilize technology that is in place, available for implementation or expected in the future (in literature referred to as ‘E-readiness’) and

b) the ability and willingness of information providers to provide and communicate the necessary information which might be available, could be made available or could be expected for utilization in the future (referred to as ‘T-readiness’; Fritz and Schiefer, 2010).

E-readiness could take care of issues as diverse as technology, literacy of people, organizational conditions in the sector, agreements on standards, etc. T-readiness clarifies barriers through data ownership or analyses the ability of enterprises to provide the necessary information. This could involve a clarification regarding information sources and, e.g., the possibility of using data bases or certificates instead of process monitoring schemes.

6 Readiness

Information and communication technology (ICT) developments, especially in the area of Internet related technologies, are fast paced and provide potentials for companies to improve transparency processes along the food value chain. The integration of technology into transparency processes builds on an analysis and mapping of the sequence of process steps and functionalities with relevance for information supply, information processing, and information communication. The various process steps and functionalities are linked with technology devices and communication networks of a certain level of technology (e.g. low, medium, high) that fit together and avoid technology breaks as much as possible. With this approach one could develop a set of technology driven reference processes each one based on a different level of technology (Fritz and Schiefer, 2010).

A similar discussion captures the problems associated with the provision of information for transparency. The identification of suitable information sources, of information collection approaches (e.g. monitoring), the responsibility of different stages and of information exchange opportunities that fit together, lead to a predefined transparency level within the value chain as well as in the communication with consumers. This defines a reference process. Considering different levels of transparency needs allows to developing a set of information based reference processes, each one based on a different level of information provision.

Figure 14 describes the relationships between transparency needs, information requirements and transparency reference processes that could best serve the transparency needs. Transparency
processes are a fitting combination of information based and of technology driven reference processes.

![Diagram](image)

Figure 14: Relationships between transparency needs, information requirements and the delineation of a fitting transparency process.

The development of reference processes builds on an analysis and mapping of the sequence of process steps and functionalities with relevance for information supply, information processing, and information communication. However, the adoption of information and communication technologies as well as of an information provision scheme for transparency process support is not only a technological or information issue, but also an organizational problem captured in the terms E-readiness and T-readiness.

In the identification of suitable transparency processes one need to make sure that there is a fit between the levels of technology and information scheme, and the sectors’ E-readiness and T-readiness. The relationships are described in figure 15. This leads to the following argument:

If transparency needs require a level of technology and of information provision scheme that cannot be realized with the present level of E-readiness and T-readiness one needs either

a) to work on improving (invest in) E-readiness and T-readiness or
b) to lower transparency expectations.

Deficiencies in ‘Readiness’ within the sector limit individual enterprises’ interest in improving readiness within the enterprise and, in turn, their ability to link up with reference processes of higher levels of technology and information provision scheme, etc. With the absence of any guiding institution or anchor enterprise this is a vicious circle which is difficult to break.
Figure 15: Relationship between transparency needs and delivery considering E-readiness and T-readiness.

7 Embedment into reality
With the sector encompassing network view of transparency, the chances for improvements depend not only on a suitable concept and the engagement of stakeholders but the integration of existing solutions and best practice experiences. There are many different clusters of successful contributions to transparency. Examples involve

a) monitoring schemes established by enterprise groups in meat (e.g. Campylobacter and Salmonella) and plant (e.g. Mycotoxin) production,

b) the Global Reporting Initiative (GRI),

c) quality certification systems (e.g. BRC, IFS, etc.),

d) tracking and tracing schemes established by many system providers in Europe and beyond,

e) experimental solutions established by individual enterprise innovators or by closely cooperating chains, and

f) signalling systems established by e.g. retail (with the UK in the forefront of developments).

However, any analysis of needs, opportunities, and especially best practice experiences has to take into account that transparency is a dynamic concept which needs to be adjusted to changes in external scenarios (e.g. price relationships or climatic changes), in production and distribution technology, in management concepts, in consumer diets and lifestyles, or in society’s priorities regarding, e.g., social or ethical norms, etc. This has consequences for investments which are easier to activate for transparency solutions that are expected to remain stable within the foreseeable
future. To reach acceptance in the market, development proposals need to take this issue into account.

8 Summary

With a broad range of definitions dealing with transparency in literature, this book builds on the understanding that transparency is being reached if everybody with stakes and interest in food production and consumption understands the relevant aspects of products, processes, and process environments that allow to making informed decisions.

From this definition as a base, the book has moved towards an outline on how to make transparency work. The focus is not on information content which is being dealt with in the project as such but on the integration of information into a transparency scheme. This discussion shows the complexity of issues to consider but also provides a clear sequence of issues that have to be dealt with.

The view is sector oriented, i.e. the discussion is not on the efforts by any individual enterprises but on how to provide support to the sectors’ enterprises altogether and especially its SMEs to move forward in meeting transparency expectations by a core group involving

a) consumers as the ultimate customers in the chain,

b) policy and related institutions that represent society’s interests, and

c) enterprises along the value chain that are responsible for providing the food to consumers.

Starting from an identification of transparency needs, discussions on transparency would have to look at

a) the cluster of impact domains agreed upon as being of relevance,

b) the vectors of relative importance differentiated according to sectors and cultural environments, and


c) the expected changes of vectors over time.

The specification of impact domains has been dealt with intensively in the past. Less effort has been focused on the identification of priorities and the dynamics in development. The impact domains are an integral part of a chain of dependencies building on information on products, processes and production environment, leading to indicators for impact assessment and the specification of signals towards transparency recipients. These relationships need clarification regarding content, priorities (weights), and dynamics.
A specific challenge involves the identification of a framework for information collection. This involves especially the identification of the information domains that could be served through standardized data bases or e.g. certification schemes, facilitating the realization of transparency on a broader scale.

For an operationalization of transparency schemes, they have to be related to application scenarios which require information on a regular basis, on demand, or in certain pre-defined situations only. Economic considerations ask for a reduction in delivery frequency as much as possible, limiting delivery on a regular basis to application scenarios where this is explicitly required.

However, whatever needs and opportunities are being specified, realization needs to check the implementation efforts enterprises’ as individuals and as members of the food chain network would need to invest in to meet expectations. The analysis of E-readiness and T-readiness provides hints on efforts and feasibility. As this analysis might deliver different results for different sectors, regions, etc., it provides hints on differences in development dynamics and needs for support to reach comparable transparency objectives throughout the European food sector.
II INFORMATION PART²:

A Food Safety
B Food Quality

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² Earlier version published as deliverables within the EU project Transparent_Food:

**A Food Safety**
- D3.1 Food safety assessment along the production chain. Impact of raw material status, transportation and storage as well as processing, packaging and distribution
- D3.5 Specification of critical research needs and priorities with relevance for food safety and quality concerns and for improvements in food chain transparency

**B Food Quality**
- D3.2 Determination of food quality parameters of selected products according to sensorial and nutritional quality definitions
- D3.3 Analysis, evaluation, and documentation of selected ‘best practice’ monitoring and reporting schemes
- D3.4 Analysis of deficiencies (weaknesses) within traditional food processing, of improvement opportunities through process optimization or emerging technologies, and of feasibility regarding industrial implementation
- D3.5 Specification of critical research needs and priorities with relevance for food safety and quality concerns and for improvements in food chain transparency
II INFORMATION PART³:

C Food Chain Integrity

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³ Earlier version published as deliverables within the EU project Transparent_Food:

C Food Chain Integrity

D4.1 State of the art on information use in food chains with relevance for environmental, concerns
D4.2 State of the art on information use in food chains with relevance for ethical and social concerns
A FOOD SAFETY

ABSTRACT
A global analysis of the material flow through the modern food chain is presented. This provides clear a presentation of the possibilities which exist for foods to be presented for consumption in a form which is less than satisfactory in terms of the potential effects on human health. The fact that food is commercially transacted throughout the supply chain adds another dimension to the complexity of the situation presenting, as it does necessity to reduce costs.

By segmenting the food supply into plant- and animal- derived, raw materials, and following their progress until retail and consumption, the major elements of food safety are tracked and traced. From this the major issues related to food safety are presented and discussed. The major hazards and risks associated in primary plant and animal production and their corresponding transformation phases are presented and discussed succinctly. The role of persistent (unaltered by processing) chemical contamination from primary production, the introduction of pathogens in animal production and their modulation through processing, the introduction of potential new hazards from food contact packaging materials are examples which are developed further in the accompanying text. The most important research needs are as follows:

i. **Food chain complexity and emerging risks:** Besides the implementation of new technologies for transferring quality and safety data and improving the coordination between the different stakeholders of the chain, the point of sale and point of use impact of the consumers on quality and safety has to be investigated. Additionally, the transformation of available product quality and process related information into signals with regard to the consumer information needs remains a core task. Emerging risks bring particular challenges in terms of transparency and consumer / stakeholder confidence and require special attention.

ii. **Analytical methods:** New processing technologies require new analytical methods. In general, fast and non-destructive methods with appropriate detection limits are required in order to guarantee a high degree of safety and quality and thus, to build a basis for trust.

iii. **Food processing technologies:** A re-evaluation of existing technologies from a food quality point of view seems essential, since there is no systematic approach and certain critical points are only revealed accidently. Concerning emerging technologies, performance criteria and indicators have to be established. The development of manageable industrial scale technologies in order to translate the consumer perception into innovative products will be a key step for the further successful development and integration of emerging technologies.

iv. **Food safety governance:** The EU food supply is manained safe by a combination of state and commercially-driven controls. Legislation is largely harmonised but the capacity of states to implement and apply this varies considerably. Commercial, brand-protection systems, are very often less sensitive to national variation in terms of their stringence. In depth knowledge as to the interaction and role of the various systems across the EU space which, together govern the safety of the chain, will enable new levels of transparency.
1 Introduction

Food quality and safety depend on a great variety of influence factors, starting from the maintenance of several food hygiene concepts, regulations, laws and the implementation of an appropriate quality management system to the assurance of certain quality and safety requirements.

The food value chain is a very complex construct, in which primary production and processing companies are often thousands of kilometres apart of each other so that the product streams are extended over the whole globe. Thereby different commodities are modified, merged and/or packaged and are passing several processing steps, which have great impact on the resulting product quality and safety.

Besides the product stream, the information flow is of great interest: the communication along the chain, the compatibility between different technologies as well as the management system and quality standard used play important roles. A challenging part in food quality management remains the information flow and communication along the food chain in order to transfer relevant data to subsequent steps of production.

The following sections discuss deficiencies and research needs in the food chain with regard to transparency in the food safety and quality domain. Food processing and legislative issues as well as challenges regarding the information flow and the communication of information are outlined.

2. Transparency in the Food Chain: Food safety, structure and signals

The food chain is analysed here according to various categories of raw material type and the routes by which they can be presented as human food. To simplify presentation the food chains are represented as discontinuous, where one output will be the input in a subsequent scheme. In sample products elements are developed in a more complete manner.

The following phases of the food chain are presented.

**primary production: animal line**

**primary production: plant line**

**Processing: animal line**

**Processing: plant line**


Retail, Food service and the consumer

For each phase a diagram shows the various routes of product flow and a number of notations describe documents, organisations and other supporting information. Following this general and more detailed information is given on the key hazards, with particular emphasis on that which is specific for this line / phase.

2.1 Primary production: animal line

Plant associated, vestigial and cumulative chemical hazards (of environmental, phytopharmaceutical and biological origin) are major safety concerns in this domain, independent of the final animal species in question. This concern is general throughout the food chain and recurrent in subsequent chapters. The passage of persistent chemical species throughout the chain is a current and potential source of grave concern for many consumers. The cumulative, delayed (long term), manmade and drastic nature of the pathologies possibly associated with exposure to such hazards, gives them a particular position in the eyes of the consumer. The direct corollary of this is the acceptance of organic products as being intrinsically safer and more nutritious. Another facet of this category of hazard is the fact that the detection and quantification of chemical species at the levels at which they are considered to be relevant, is very often highly demanding in terms of instrumentation and human resources required. The resulting high costs of analysis are most often aggravated over time as the technology improves and accurate determination is possible at ever lower quantities.

Feed production

The production of foods from animal origin does not start with the primary producers of the meat or dairy. It starts a few steps earlier, with the production of the animals and the animal feeds. We propose here not to take into account the breeding of the production animals as this does not fit in the scope of this chapter. The production of animal feeds, however, has very direct links to food safety as well as to transparency issues and is therefore important to deal with here. Feed production start with the production of raw materials in many countries all around the world. Feeds usually contain ingredients from all over the world: soy beans from Canada, the US and increasingly from South America, coconut from South East Asia, maize from Central and South America and numerous ingredients form Africa. This underlines the necessity of considering food safety from the very beginning of the food chain.

Herbicides and fungicides are stringently controlled at the level of introduction to the market, application practices and levels permitted in intermediate and final food products. Indeed
legislation is often so precise for any particular agent in any particular product that it almost impossible to summarise. Legislation does vary between economic zones but the MRLs of CODEX ALIMENTARIUS are essentially followed by legislators. CODEX’s Codes of Practice are also widely followed and demanded. Commercially-applied specifications vary quite considerably, always in the direction of more stringency that the relevant legislation.

Toxins of biological origin, of which mycotoxins are certainly the most important in this respect, are also the subject of strict controls. Controls include those aimed at agricultural and post-harvest practices and the levels of the specific toxins in any particular product are likewise very toxin / product / intended-use specific. A significant proportion of CODEX’s Good Practice Guides are centred on the control of mycotoxins in specific plant groups.

Chemical contamination of agricultural plants via air or water (environmental contamination) includes heavy metals; lead, mercury, cadmium etc and persistent PCBs (dioxins) and are also the subject of concern and preventative measures from the earliest part of the food chain. As mentioned above many of these chemical species are not diminished in the food chain and some are in fact accumulated in certain tissues of certain food animals.

Animal Breeding:

The FABRE technology platform (http://www.fabretp.info) has summarized the major food safety issues which can be addressed at the level of animal breeding. It is known that farm animals differ as to their intrinsic responses to zoonotic human pathogens but the relationships between these hosts and their pathogens are complex. Certainly it is suggested that the simple selection of resistant animals is likely to be only a part of an overall role for breeding and enhancement of food safety. It is likely that as more is known of the basic science concerned with host-pathogen interactions, that greater role will be found for animal breeding in the maintenance of safety in the food chain. If and when genetically modified farm animals become introduced into the wider food supply this role is likely to become even more pronounced. Such modified animals might be selected and designed to be intrinsically safer.

Animal Production:

Aside from the accumulation and transmission along the food chain of persistent, feed-derived chemicals which has been dealt with above, the colonisation of farms animals by human-pathogens (zoonotic agents) is another major concern.
Of these, Salmonella is endemic in many farmed, land animals. However a number of initiatives exist to reduce or eliminate this pathogen from certain species. Certainly Denmark, for example, is making great efforts to eliminate Salmonella from its chicken production. However it would be unwise to suggest that, according to the current and foreseeable practices adopted around the world, that the major zoonotic organisms (Campylobacter, Salmonella, and VTEC E.coli) will be eliminated from primary animal production.

2.2. Primary production: plant line

The primary production of plants for use as food is both the most local and most global of all production systems. The scale of commercial operations ranges between smallholders producing for local consumption through to the very biggest of industrial conglomerates producing commodities for the global market. In this context there are very few common food safety issues which are relevant to all types and scales of product. These considerations are presented here on the understanding that they might only be pertinent in certain situations.

General Considerations.
1. Vestigial and cumulative chemical hazards (environmental, phytopharmaceutical and of biological origin) are major safety concerns in this domain, these are always an economic cost independent of the public health relevance. This point has been more extensively discussed in section 2a.

2. Microbiological (bacterial) and other biological (viruses) are also considerable sources of concern in situations where animal (and human) derived water and waste is permitted to contact with the plants whilst being cultivated and in the case of dried herbs and spices. Of the former type of situation, serious problems have been recorded in the case of E. coli O157/H7 on whole canteloupe melons. In this case the contamination was passed into the flesh of the fruit on cutting. The latter must certainly include sporulating pathogens in herbs and spices.

Problems caused by the microbial contamination of cultivated plants, through animal-contaminated irrigation water illustrate how the modern food chain can cause problems which might previously never have developed. Factors such as; the long distance transport (including export) of perishable soft fruits, permitted by modern post-harvest technologies; intensive animal husbandry and the effluents it produces; the rise in popularity of minimally processed, ready to eat, vegetable preparations; - all contribute to the exposure of consumers to pathogens in a ways which might not have occurred previously. The seriousness of the pathologies provoked and the fact the foods in question are not normally associated with acute health risks, accentuates the consumer concern and general profile of such situations.

3. GM is obviously a consideration and is included here in the safety domain for completeness. This is, of course, a major transparency issue independent of the fact that no clear evidence exists of direct human health issues related to the consumption of genetically modified plants, animals or microbes per se. EFSA has a specific panel for the evaluation of genetically modified crops for foods and other potential GM inputs into the food chain. (http://www.efsa.europa.eu/en/gmotopics/topic/gmo.htm).

4. Although it is generally recognised that HACCP principles provide the best basis for assuring that companies can produce food which is consistently safe, it is apparent such principles are not readily applicable to primary production. In the place of formal HACCP plans, primary producers are most often required to comply with rigorous codes of good agricultural practices. This is particularly so for those supplying the modern food chain who
Transparency in the Food Chain

are often obliged to obtain certification of compliance with recognised standards. The standards from the GLOBALGAP initiative have replaced the equivalent measures from the EUREPGAP organisation which were previously the accepted certification here. www.eurepgap.org, www.globalgap.org/

Transparency in the food chain: Food safety, structure and signals

2b. primary production: plant line

2.3 Processing: animal line

The scope of this section includes all elements of “post-harvest”, initial processing of animals; collection, capture, slaughter etc, through to classical “making-safe”, processing of the major product lines.

1. Plant –derived, vestigial and cumulative chemical hazards (of environmental, phytopharmaceutical and biological origin) are major safety concerns at this level, this varies widely between animal species in question although certain hazards are common to a number of species. This point has been more extensively discussed in section 2a.

2. Bacterial hazards are of major concern from primary production, through slaughter, processing, transport, distribution and consumption in all types of animal-derived food.. Bacterial hazards
vary from species to species and food-type to food type, although some are common to a number of species. Interventions aimed at managing the risks associated with pathogenic bacteria are applied throughout the production chain, although certain food / animal types are known to be critical. In such cases legally stipulated interventions often exist. Examples of these include strict butchery practices and post-mortem inspection of slaughtered animals, pasteurisation regimes and 12D cook for low-acid canned products. The rich medium which animal products often represent to contaminating bacteria, means that their introduction during processing is also a major concern. This process-derived contamination, can be human derived, cross contamination (raw-material to processed food) or environmental introduction.

3. Certain parts of the food chain are particularly relevant for the proliferation / control of specific hazards in specific product types. The safety of a specific processed product quite often depends on one or other specific intervention which can either inactive or inhibit the growth of target pathogens. The efficiency or adequacy of these interventions is often only questioned after it proves to be no longer adequate for the control of the target pathogen or causes the development of new risks. Hence, for a number of food categories, the cold chain is of primordial importance, although it is also the selective pressure which is partly responsible for the emergence of *Listeria monocytogenes* as a highly feared pathogen and has revealed a new route for the development of risks from psycrotrophic *C.botulinum* and *Yersinia enterolytica*. The emergence of *Enterobacter sakazaki* as a risk in powdered milk formula is another example of a process driven risk. Therefore it is even for the thermal and chemical-based processes, which have made up the palette of interventions for the making safe of animal based foods for decades, that new hazards can gain relevance. Indeed even known hazards can present new levels of risk in certain categories. It would not be inconsistent to assume that the widespread application of what are grouped together as “novel technologies” (see 6) would not also select for unforeseen, problematic scenarios, although this is, of course, speculation.

4. Veterinary pharmaceuticals are also of major concern in as much as they persist to a greater or lesser extent through the processing stages, these have been dealt with in more detail above. (Dealt with above).

5. The implementation of HACCP principles is most appropriate in cases of microbial hazards in processed products.
6. Novel preservation technologies can play an important part in increasing microbiological food safe in animal products. The most developed method for application in meat preservation at this moment is High Hydrostatic Pressure. Other methods like High Intensity Light (pulsed visible and UV light) as well as Pulsed Electric Fields may be less applicable in meat preservation as they are more suited for liquid products and products from the plant production line (see paragraph 2.d). It should be noted that the discussion on the safety of novel preservation technologies for the consumer is still going on in the media. The consumers’ perception of their safety may not reflect the scientific evidence about it and as long as this discussion has not settled they may be seen as potential sources of distrust.

2.4 Processing: plant line

1. Vestigial and cumulative chemical hazards (environmental, phytopharmaceutical and of biological origin) are major safety concerns although this varies widely
between the species in question although certain hazards are common to a number of species. This point has been more extensively discussed in section 2a.

2. Bacterial hazards are only of major concern in certain specific situations, such as *Clostridium botulinum* in low acid canned vegetables and psychrophilic *C. botulinum* in sous-vide and other vacuum packed RTE’s.

3. Certain parts of the food chain are particularly relevant for the proliferation / control of specific hazards in specific product types. The cold chain is of not of the greatest importance - except in Ready to Eat products.

4. The relative stability of many processed, plant-based products the most globally distributed of all categories. Therefore their hazards are likewise globally distributed. Vegetable oils, whole and milled grains and transformed derivates of these, are commodities which are rapidly transported around the world and incorporated into a very large range of products. The distributed nature, and the fact that that relevant, persistent, hazards are often incorporated in the very earliest stages of production (primary production, post-harvest storage) a long way from processing or consumption, makes this type of problem very particular.

5. HACCP principles most appropriate in cases of microbial hazards in processed products.

6. Many processed plant derived products are either staples (e.g. cereals derivatives) or regularly consumed by many populations (e.g. fermented beverages). In such cases they may be particularly relevant for the transmission of vestigial chemical species as the exposure is so long term.

7. Like in animal products, novel preservation technologies can play an important part in increasing microbiological food safe in plant. The best developed method at this moment is High Hydrostatic Pressure, but other methods like High Intensity Light (pulsed visible and UV light) as well as Pulsed Electric Fields increase in importance for shelf life extension of plant products, both liquid and solid. It should be noted that the discussion on the safety of novel preservation technologies for the consumer is still going on in the media. The consumers’ perception of their safety may not reflect the scientific evidence about it and as long as this discussion has not settled they may be seen as potential sources of distrust.
2.5 Retail, Food service and consumer

1. Bacterial hazards are of major concern in foodservice/catering and temperature/time control, and basic hygiene are the major tools controlling these. Well known correlations exist between practices and the development of specific groups of hazards. *Clostridium perfringens* poisoning is a very good example, being largely caused by improper cooling of cooked beef products in catering scenarios. Certain pathogens have emerged (or increased in importance) more recently which are of particular relevance in this subsector. Certainly VTEC *E. coli* and *Campylobacter* spp. can be included in this category.

Cook-chill, sous-vide and novel, experimental cooking techniques also bring with them new possibilities for certain pathogens to proliferate or permanence. In these cases the standard interventions based on cleaning, separation and temperature control may not offer the protection necessary.
2. Viruses are also of concern in catering / foodservice, particularly the Norwalk-type and those with similar behaviour. Food borne viruses have not generally been considered to be transmitted through the food chain, but rather introduced by poor personal hygiene practices of infected and carrier individuals working in food handling. This perception is currently being reviewed as evidence is mounting that persistence through the chain is a bigger problem than was once thought. Outbreaks, whilst rarely serious in terms of morbidity and mortality, quite often involve large numbers of people and as such can be highly visible to the general public. Dramatic “public health” measures can also be taken – such as the impeding of cruise ships docking in ports or the commercial declassification of hotel chains or tourist destinations – which add to the recognition of this hazard in the general population.

3. The branding of a wide range of products in modern distribution (supermarket) chains brings high levels of exposure in the case of real, or suggested, safety issues. Thus any question of lack of safety of such branded products can effect the overall brand. The safety-driven, brand protection specifications driven by large supermarket chains e.g. BRC, IFS) are famously stringent. The safety demands are often in excess of what is legislated and are always non-negotiable. This potentially excessive stringency is, of course, passed back down the production and supply chain. The commercial definition of specifications is not exclusive to supermarkets, brand-holding producers often practice their own, non-negotiable schemes with suppliers and co-packers. An important issue in packaged, branded products is particulate, physical contamination. Hazards such as glass and sharp plastics provoke damage in consumers which is direct, immediate and often of unarguable in cause. For this reason such hazards are explicitly and stringently controlled in all brand – protecting, commercial safety standards.

4. Food contact packaging materials are important potential sources of exposure to certain chemical hazards and these are highly controlled in the food chain. Certain packaging systems in which food contact is accentuated are indeed specifically demanded by supermarkets (e.g. individual, blister and vacuum packs for the cold chain and interleaved sliced hams and cheeses). It is well known that consumers have particularly strong and deeply felt concerns about vestigial, chemical contamination with delayed pathological effects. Food contact derived contaminants would, in those cases where they might, in fact, represent a genuine risk, be included in this category. This type of scenario is an example of an accentuated perception of risk, of hazards which are most probably relatively inoffensive, but which is potentially damaging to consumer trust in the overall food chain.
5. Certain food products are developed and marketed specifically for consumption by potentially vulnerable groups, certainly children should be included here. In such cases the potential importance of specific hazards might be accentuated in the eyes of the consumer (or the carer in the case of children).

6. European legislation for food hygiene in commercial food operators (Reg 852 et seq), whilst flexible, requires considerable interpretation by local enforcers. The obligatory application of HACCP principles to even the smallest catering / foodservice operators, which is / was the case for those member states which did not negotiate exceptions, caused considerable problems and created tensions between enforcers and companies and their associations.

7. Many jobs in retail and foodservice are unskilled and poorly paid and quite often companies find it difficult to attract and maintain staff for certain positions. In some cases, particularly in the case of foodservice, these positions can be critical to food safety. Thus high levels of staff turnover can be a serious impediment to maintaining adequate levels of consumer protection in certain types of business.

8. The domestic user / processor of food products has a major role in securing the safety of the consumed product. From the obvious requirement to cook a wide range of raw products before consumption to the necessity to respect shelf-life information, a wide range of safety practices are required from the user / consumer. In the case of novel products and product concepts, safety information may require to be given at new levels of explicitness.

9. The control of allergens in processed and complex food is largely effected by explicit labelling i.e the level of probability of any product containing a particular allergen is codified on the label. From explicit “Contains Nuts” warnings to more the circumspect “Has been processed in a factory which also processes Nuts”, such messages are the essence of the strategy of preventing unintended allergic food reactions.
2.6 Generic safety issues and their communication through the chain

Since the publication of the White Paper on Food Safety in 2000, a number of public entities have been created, or have gained a clearer role in many aspects of food safety which are particularly relevant to transparency. Indeed the concept of transparency is central to the functioning of all of the EU, food safety agencies and all publish all relevant deliberations as much as possible. Whilst essential to the credibility of the institutions and the processes involved, their relatively invisible nature, in the eyes of the consumer / citizen, means that this transparency does not always “trickle-down” to this group.

The most emblematic of these institutions, at least at the EU level, is probably EFSA (the European Food Safety Authority). This agency occupies the role of the European Commission’s scientific advisors on all issues related to food safety, particularly in risk assessment. EFSA also has a role of communicating risks to the food chain and to the final consumer and thus is one of the major gatekeepers of consumer-relevant, transparency.
National Risk Assessors and Risk Communicators – articulate with EFSA in these functions in the member states, these are often even more important as transparency gatekeepers as they speak more directly to citizens. These entities are functionally separate from their corresponding control bodies which are headed by what is known as the Competent Authority. The concept of a specific Competent Authority for control of the food chain in each member state also has its origins in the White Paper. The CA is that organisation in a member-state which is statutorily responsible for the official control of EU food safety legislation. The fine details of the legislation and the on-the-ground interpretation of what the law is actually demanding, is the responsibility of the CA and is often a source of transparency issues. An example of this would certainly be the different levels of permissiveness to the use of wood contact surfaces in food service.

The Food and Veterinary Office of the EC is a department of DG Sanco (http://ec.europa.eu/dgs/health_consumer/index_en.htm) which has as a major function, the monitoring of compliance, of member states, with the EU legislation regarding food safety and related concerns.

These are not the only official bodies with roles in food safety within the EU, there are many others, both at the community and member state levels. Food safety touches on the competences of ministries (and Directorate Generals) responsible for agriculture, health, research, education and the economy, and all will have some voice in this matter. Official bodies do have a particular responsibility in “policing” transparency as their very official nature implies an elevated and exempt position. Such a position necessarily brings with it authority, in the eyes of the citizen / consumer, and thus extra responsibility.

*Forms of recognition of compliance with technical demands; how tacit and explicit food safety signals are felt through the food chain.*

All foods offered for sale to the European consumer are done so within the context of the legal framework of this economic space, even though, in the case of imported products, these might be produced and processed in other legal environments. The law which relates to food safety, in either of the above cases, must be considered the baseline for rigor, complying with the law is a license to sell foods. Evidence of occasions of non-compliance are mere indications that the law has been broken, they cannot be considered to imply that the foodstuff will cause disease. The nature of the forms of detection of non-compliance; analysis of samples; as a consequence of inspection; due to complaint, are such that, even if compliance is demonstrated, it is not possible to be sure of the safety of the food in question at all times. Therefore, the legal criteria which are applied in the realm of food safety are essentially a minimum baseline (rarely, and even so - only quite recently,
based on science), and the methods for detecting legal irregularities are assumedly and necessarily not sufficient to afford a genuine “control” of the food chain. This is an obvious statement, the law and its application is there to provide a policing of safety of the food chain, making the food chain operators realize that if they do not comply they might be detected and this giving them an incentive to comply. Although the statement is obvious, it is also a fundamental part of the reason that brand owners choose to apply more stringent criteria to the safety of their products and to police these criteria in a manner which goes much further than those which are applied by official bodies. Even though it is thankfully rare for any particular product to carry an explicit, affirmative food safety message, the tacit messages from the projection of brands, demand that such stringent systems exist. Hence the many “off-label” references to safety, most of which are very indirect, which support branded food products, are supported by criteria and vigilance systems which go very much further than those demanded or effected by the law and its officers.

Food producers obviously control their own production through line management. The food safety principles and practices which are employed in these companies will be effected through the internal discipline of the company. Where the producer is the brand owner it will be very conscious of the value of the brand(s) in question and therefore of the risks of loss of control of food safety. Where a brand-owning producer also has co-packing contractors, it obviously cannot use its own line management to effect the discipline required to assure food safety in the co-packers. In such cases the food safety practices demanded of the co-packer will have to be stipulated in great detail and be controlled via contract and audit. A similar approach is employed by the supermarket chains which have their own label products produced under contract manufacture. Indeed in the case of the major supermarkets a number of certification systems exist which have effectively outsourced the technical aspects of the contract and audit approach. The European certification schemes of the British Retail Consortium (BRC) and the International Food Standard (IFS) occupy precisely this position, certification of a producer by one or other of these standards is a non-negotiable prerequisite of being able to supply own label products to supermarkets. The tacit communication to the consumer of the safety and salubrity of supermarket own brand products are supported by these certification systems.

2.7 Transparency issues and barriers hindering transparency throughout the food production chain

Transparency in the food chain is directed both by consumer pull and by industry push. Consumers want to be able to get easy access to essential information as e.g. allergen information and other
Transparency in the Food Chain

relevant characteristics. Producers can provide this information and much more if wanted or if demanded by the authorities. It is interesting with this respect to discriminate between different levels of transparency, e.g. active transparency (obligatory information, equivalent to disclosure in the USA and Canada on the one hand and passive transparency (accessible for the consumer, but only if asked for), e.g. information on the farm that produced the meat of the dairy via a web site of the distributor.

Though transparency in the food chain is an important issue throughout the entire food chain and concerning all relevant information, it is mostly considered as directed by consumer pull. In the case of food safety, however, more than in other quality aspects, transparency is important throughout the chain. This means that (e.g. in the animal chain) it does not start with the primary producers of the meat or dairy, rather it starts two steps earlier, with the importation of raw materials for feeds from many countries all around the world. The feed producer should be able to give all wanted information on safety to the feed distributor who in his turn must be able to provide the pig, beef cattle or dairy farmer with all information that is important for the meat or dairy processor.

This illustrates the fact that in the case of food safety most of the signals are business to business information (B to B) rather than business to consumer (B to C). The communication between professional players in the food chain is essentially technical and very explicit, systems such as BRC and IFS are extremely clear as to what is demanded of suppliers.

Food safety is usually considered as a given. This implies that signals that communicate food safety of a particular product may suggest that the competitors’ products are not safe, putting in question the safety of the very chain. Sectorial associations and federations are very important in harmonising the industry’s approach to the communication of food safety to the consumer. One concrete measure is to make food safety non-competitive in the eyes of the consumer by promoting the sharing of information relevant to food safety throughout the industry. Traceability, for the purposes of maintaining safety in the food chain, is essentially a professional currency which is supported by a range of methods which are have only recently been made possible due to advances in information and communications technology. European law demands that a batch of raw material be able to be traced through to all final products which it appears in. Similarly a final product must be able to have all its raw materials identified. Such information is not explicitly available to the final consumer, but the obligatory exposure of the brand owner and producer to such demonstrable evidence of authenticity is a major driver of transparency. By such means the food industry can prove, or not, that its presumption that the food chain is intrinsically safe. However the existence (and persistence) of detailed information on the fine composition of foods throughout the chain, brings up other concerns. One of the most important of these is the level of
transparency in the food chain. the same commercial power which can permit certain elements of the chain to exert undue influence on suppliers can also influence the very availability of certain elements of information along the chain leading to serious transparency issues.

most of the relatively few, explicit b to c food safety signals, are from the restaurant sector, of which is the “smiley” from denmark is a government-enforced example. a number of signals have food safety within a more global message, such as the uk’s red tractor which is partly communicating safety as part of a territorially based badge, this general indirect communication of safety through such signals is discussed below.

a set of signals and parameters that illustrate the importance of transparency in food safety will be described here and these will be defined this in terms of transparency, or barriers hampering transparency and its signals.

the following transparency domains are proposed to as related to food safety throughout the production chain (table 1)

### 2.8. Transparency domains relating to Food Safety

**Table 1. Transparency domains related to food safety throughout the production chain**

**Compositional:**
- Chemical hazards;
  - Free from or compliant with;
    - Heavy metals, combustion pollutants (PAC’s, PCB’s dioxins), pesticides, veterinary pharmaceuticals, nitrates, SO2, process-derived hazards, packaging migrants.
- Biological hazards;
  - Free from or compliant with;
    - Microbial pathogens, microbial (inc fungal) toxins, allergens, plant toxins, shellfish toxins.
- Analytical considerations;
  - Recognition of rigor
    - Accreditation; official (ISO standards) and commercial (eg
Transparency in the Food Chain

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Technological:

- Primary production
  - GM / non-GM, country source (safety-relevant), organic.
- Processing
  - traditional vs. emerging technologies
- Packaging
  - Active, novel (retortable flexible), intelligent, migration hazards.
- Transport and distribution
  - Temperature control, traceability
- Use
  - Intended use, tacit and explicit, catering/restaurants and domestic consumption.
- Abuse:
  - Adulteration, criminal recycling (re-dating etc) for financial gain
  - Sabotage by 3rd parties for criminal reasons (financial)
  - Bioterrorism

Organization and discipline:

- Recognition of management practices/systems – relevant for safety
  - Legal: compliance with legislation – tacit recognition; product category, animal production, food hygiene – incl HACCP & traceability
  - Voluntary / commercially-driven; ISO 9001, ISO 22000 etc / Eurepgap, BRC, IFS, BRC-IOP. System 5 - Product certification.
2.9 The need to improve transparency in the food chain with regard to food safety

The description of transparency domains is limited to few examples of issues that relate to active or passive transparency and the barriers that should be addressed in order to find solutions to these problems.

There are many examples in the table of transparency domains (table 1) that can be used to illustrate the need to improve transparency and the challenges to be faced in this process. In the primary production and processing of meat for example it is still very hard to retain and channel the information on origin etc. after slaughter. This general area of traceability is at one level conceptually simple i.e. the flow of food, forwards and backwards along the food chain needs to be able to be traced. But when the unit of traceability requires to be defined it becomes more complex. Animals come in unit packages – the animal. It might be feasible to follow bovine meat up and down the chain at the animal level but this would be far more challenging for chickens, rabbits, fish etc. The situation becomes even more complex when the final product is a packaged ready meal or some other composite product. Thus traceability, for the purposes of maintaining safety in the food chain, is essentially a professional tool, and traceability information will not normally be explicitly communicated to the consumer. This is not to say that information might not be become available to the consumer, through bar-codes on packaging that can be read by smart-phones and used to access information on the internet. However it is not clear that the consumer will be able to decipher the relevance of this information especially as relates to food safety.

The communication of food safety information tacitly, as part of a wider communication of “credibility” has been introduced above regarding the importance of brands. A further, collective example is the officially endorsed (IPG, DOP, DOC etc) information regarding country or region of origin, which carries an implicit safety claim.

Similarly, information concerning the specific processing employed in production can carry an implicit signal of product safety. Examples of this would include the use (and declaration of use) of a novel preservation technologies to extend shelf life such as microfiltration in pasteurised milk. Such information is relevant for the consumer or food service worker with regard to the intended use and preparation of the product.

Whether intended adulteration or other intentional illegal acts which result in a food product being unsafe to consume can be dealt with existing food safety rules and practices is highly dubious. Indeed knowledge of food safety systems is required on the part of the criminal to enable him or her to avoid detection. In any case, any incident caused by intentional acts is likely to accentuate the
consumers concerns about the safety of the food chain, especially as such incidents war often dramatic and newsworthy. Hence it is necessary to address this area in the context of transparency.

In the case of criminal abuse for gain, a criminal recycler, e.g. re-dating or re-packing out-of-date products is in fact deliberately misinforming the consumer. Thus, if detected and publicised, such cases bring honesty of the information on a package into question. Likewise the food processor in a who deliberately mixes melamine into dried dairy products is passing the unsafe product off as an intrinsically safe, standard product. The lack of transparency in these cases is the intent of the “producer”. In these cases of serious crime in the food production chain, either for financial gain or from a political motivation (e.g. bioterrorism) improving transparency requires the active and visible investigation and prosecution as well as implementing preventive measures or communicating widely the fact that such measures are in place.

The barriers hampering transparency in the above cases are clear. They are the result of deliberate actions by the person or organisation responsible for the adulteration of the products. In many cases however the barriers causing a lack of transparency can be more subtle and less obvious and the consequences may be considerably less serious. Nevertheless also in these cases, the results may cause grave harm to the consumer. Simple neglect or underestimation of the consumers’ interest or the fear of being challenged by the client may cause that essential information for the consumers’ health and safety is deliberately withheld from the client. Certainly the omission of relevant allergen advice on a product would be an example of this.

A lack of comprehension or overview of the activities of other chain members upstream or downstream in the supply chain may mean that the importance of information is not well perceived and therefore not given. A third cause for an actor in the chain to decide not to provide transparent messages may be the fear of disclosing confidential information to competitors. Even when there is no deliberate decision not to provide the information, it may be withheld from the consumer if the information is really there but the producer has failed bring it to the consumers’ attention. Finally, a lack of knowledge about the available solutions for a problem, their capabilities, how to use them and the (over) estimation of the costs involved may mean that solutions, though available may not be chosen and essential information is not given.

There are a few more intrinsic causes of information not being available where it should be. Transparency may be easily confused with traceability, which may lead to the conclusion that having an active traceability system implemented, there is no need to do anything more. In addition, the ownership of information relevant to food safety (most obviously linked to traceability) may be an issue, i.e. one part of the chain may demand that certain practices are effected but the recording of
the relevant information may be retained by the strongest partner in the transaction. Technical difficulties may hamper transparency when e.g. bulk goods are repacked and the units of traceability are changed thus impeding the specification of the resulting units with regard to statements on quality and safety. Even when the statements seem to meet all demands, the actor in the chain may not see the necessity to verify them and to and to make them available to the client or the consumer. Finally, signals from certificates are usually based on trust in the certification body and consumers may not have an access to additional information that is essential.

3 Specification of critical research needs and priorities with relevance for food safety and quality concerns and for improvements in food chain transparency

3.1 Food chain complexity and emerging risks
Today, the food value chain is a very complex construct, in which primary production and processing companies are often thousands of kilometres apart of each other so that the product streams are extended over the whole globe. Thereby different commodities are modified, merged and/or packaged and are passing several processing steps, which have great impact on the resulting product quality and safety.

Besides the product stream, the information flow is of great interest: the communication along the chain, the compatibility between different technologies as well as the management system and quality standard used play important roles temperature.

3.2 Critical impact factors regarding food safety
The following transparency map (Fig. 3) was drawn up to describe how food safety-relevant information that is gathered along the food is employed by brand holders (including supermarkets).
When food products pass through modern, brand-driven chains the levels of stringency are more harmonized across national borders. This is essentially due to the fact that major brand holders will stipulate key specifications for food safety, often anticipating and/or exceeding legally imposed levels of protection according to current scientific knowledge. In addition, the rigor in the application of the controls imposed is also greatly harmonized thus further reducing country-to-country variations (www.brcglobalstandards.com, www.ifs-certification.com). Commercially imposed controls are characteristic ally “non-negotiable” in the sense that once applied, either by the brand-holder or the “owner” of the certification scheme, their compliance is obligatory in order to have access to the chain. Very often the specifications demanded imply extra costs for the suppliers. Although largely based on risk and on scientific principles, there is no obligation for them to be so. Providing that any specification affords a protection, which is at least equivalent to that which is required by law, the client can demand whatever he wants. There is therefore a business dynamic of suppliers being dependent on brand-holding clients who can make safety demands which are based entirely on their own criteria. The lack of transparency in fixing specifications is certainly a cause of tension between suppliers and clients. (Willems et al., 2005).
Research is needed on the following topics:

i. Intentional and unintentional alterations in practices related to sourcing, formulation (including preservatives), processing, packaging etc. may lead to production of or selection for new, unforeseen risks.

ii. Post-shopping technology and food preparation at home as part of the chain: point of sale and point of use impact on food quality needs to be taken into account.

iii. Foresight and scenario studies with experts and modeling approaches should be used to identify and prioritize potential hotspots of emergence in the food chain.

3.3 Communication with consumers and society

At the end of the food chain, the main focus lies on the link to the consumer. There, the product packaging or the declaration at the counter is commonly used to present information of ingredients, logos of test results and to highlight the products’ benefits. The producer also gets in touch with (potential) consumers using TV, radio, print and online advertising to convince them of the benefits and to stimulate them to buy their products.

If these linkages should be used to increase the transparency and to enhance the consumers’ trust, the selection of relevant information is of great interest:

1. Which kind of information is needed to create trust?
2. How much information is sufficient?
3. When does an information overload occur?

These are the questions of interest in the context of searching possibilities to increase transparency in the food sector. The limiting factor is not the availability of information, since the quality as well as the quantity of analytical methods and information transfer technologies rapidly increased during the last years.

One possible solution concerning question 1 could be to clarify and to communicate full and transparent information on both risks and benefits for traditional and novel products. This needs good cooperation between researchers, policymakers, industry and consumers. A successful example of assessing the risks and benefits and communicating them to consumers is cheese made from unpasteurised milk: clear procedures for production and labelling allow consumers to make their own choice. The problem is, that in other areas the real risks are not yet always so well quantified and unsubstantiated opinion can counter development.
Furthermore there is often a lack of trust because of the poor knowledge of the consumers regarding the food production. Thus, imparting relevant knowledge of the science and technology would be a solution to increase it. All research, education, innovation and business communities should be transparent, open and clear about all developments if the sceptical and negative feelings of some parts of society to novel products and processes are to be overcome, e.g. by using new ways of communication like twitter, youtube, and facebook.

Scientists and technologists need to become more aware of societal perspectives and both understand and address these throughout their work; proper, balanced communication on the risks and benefits both of commercialising processes and products or not is essential. Communication needs to be with members of the public with all levels of education rather than just an elite and attention is also needed for communication on the implications of food industry developments for the various sectors and stakeholders. Overall, better communication can support the improvement of the public image of the food industry by both improving public understanding of the science and technology and increasing awareness among scientists, technologists and industrialists of what the public is really concerned about. All those involved in food industry commercialisation, R&D and education must include open and accurate communication with the public as part of their roles and take account of public perception in planning and carrying out their work programmes. Coordinated action on specific topics is required.

It is also required to develop knowledge representation and decision-making tools based on stakeholders needs of the whole processing chain and on the development of knowledge reasoning models and tools that will go until the resolution of conflicts.

Research is needed on the following topics:

i. Who needs/wants which information and what for? **Relevant information for transfer along the chain has to be selected** in order to avoid confusion (due to information overflow) or a lack of transparency due to missing information.

ii. **Further knowledge needs to be generated** as to how the consumer views emerging risks and more importantly how the consumer can accept some degree of new risk without losing confidence in the chain.

### 3.4 Food processing technologies and food safety

Intentional and unintentional alterations in practices related to sourcing, formulation (including preservatives) processing, packaging etc. might have consequences as the production of or selection for new, unforeseen risks. Likewise new analytical and other scientific capacities can identify risks
which had previously been unknown. The consequence in the food chain of emergence does vary according to the specifics but there are certain scenarios which would be common for any of the sources of emergence the transparency map shown in Fig. 8 describes how the collection of data on known hazards in the food chain and the interference by unknown or unsought risks reveals the need to improve our insights into the ranking and prioritization of risks according to transparency damage they may cause and to develop strategies to address the importance of consumer perception regarding emerging risks.

**Fig. 8: Transparency map: Emergence versus transparency.**

The following research needs can be identified:

i. Cumulative and long term effects are associated with exposure to chemical hazards. **Detection and quantification of chemical species** at the levels at which they are considered to be relevant, is highly demanding in terms of instrumentation and human resources required. Progressive revelation of risks via improved analytical capacity thus acts as a vector of emergence and justifies further investigations.
ii. Long distance transport (including export) of perishable soft fruits, permitted by modern post-harvest technologies and, in addition, the rise in popularity of minimally processed, ready to eat foods contribute to the exposure of consumers to pathogens in a ways which might not have occurred previously. This acts as another vector of emergence: alteration of ecology potentially selecting for new pathogens or known pathogens in new situations.

iii. Food contact packaging materials are important potential sources of exposure to certain chemical hazards and these are highly controlled in the food chain. Certain packaging systems in which food contact is accentuated are indeed specifically demanded by supermarkets (e.g. individual, blister and vacuum packs for the cold chain and interleaved sliced hams and cheeses). Consumers have particularly strong and deeply felt concerns about chemical contamination with delayed pathological effects. This is another vector of emergence, related to the first one mentioned above. The alteration and evolution of practices which modulate the food safety risks should be an issue for further research.

iv. Re-evaluation of traditional food processing: Traditional food processing and traditional food processes have been widely used in Europe in the past and do still include local particularities. These processes have generated healthy, functional foods which could also be exploited in modern society. Re-inventing these processes requires the understanding of the traditional process mechanisms and subsequently their transfer and upgrading to modern industrial processes. A re-evaluation of existing technologies from a food quality point of view seems essential. Novel processes have to undergo an intensive evaluation regarding toxicological risks etc. There is no systematic approach for the existing traditional foods and certain critical points e.g. the formation of acrylamide are only revealed accidentally.

v. Integrative food process optimization: An effective food process optimization by integrated modeling of food chains and unit operations is required in order to generate and validate data for food quality changes during food production and storage. Aspects such as point-of-sale retailing and processing and point-of-use processing need to be taken into account in terms of occurring modifications of food quality. Terms such as packaging play also a crucial role in communication, logistic, freshness and safety monitoring and need to be taken into account as well. Therefore, product-process interactions and their impact on product quality as well as the role of packaging and quality changes during storage and retail until final consumption remain core tasks that require detailed investigation. A greater integration in research is required between raw material production, processing, food quality, safety, nutrition and sustainability. Research programs need to be more collaborative between disciplines in large research topics.
3.5 Emerging technologies and Food safety

A transparency map (Fig. 9) was sketched for the gathering of data, and progressive conversion to signals for generic safety concerns of the food chain when confronted with products produced with the input of one or more novel or emerging processing technologies.

This scenario is essentially limited to products which have been produced with the aid of a novel technology and where the application of this technology is communicated explicitly to the end consumer. It might be that some direct mention of safety is made, although this is known to be rare at present. It is more common that some part of the message might allude to safety (extension of shelf life, production with less additives). Those elements of decision and data capture which will impact on the level of safety afforded (white boxes at the top left hand of Fig. 2) are, in the case of many novel technologies, still incompletely defined. As an example, “milder” food processing treatments, tend to exert their anti-microbiological effects in a more subtle and directed manner than the classical (normally thermal) methods they are designed to substitute. In such cases it is likely or even known that the efficacy of these effects will be sensitive to variability of the food matrix and thus each new application would require careful validation.

A further potential risk pertains to the “ownership” of the “brand” of the new technology in generic terms. Where the specific technology in question (e.g. specific antimicrobial edible film) is subject to industrial property protection the owner of this property will be careful to assure that its application does not prejudice the value of the technology. This is very clearly illustrated in the case of patented, functional ingredients from which functional or health claims can be made. In these cases the owning company normally controls the use of this technology completely with legally binding and extremely explicit limits to the way the technology is used and presented to the consumer. The generic acceptance of a new range of specific applications can, of course, be prejudiced by poor performance or, more dramatically, safety issues concerning a specific technology form this generic range. Whilst being obvious, this is a risk which needs to be addressed if new technologies are to be accepted by the consumer (Nielsen et al., 2009).
i. Products which have been produced with the aid of a novel technology which is communicated explicitly to the consumer – message rarely mentions safety directly but allusions are more common (shelf life extension, additive reduction).

ii. “ownership” of the “brand” of the technology in generic terms is potentially problematic. Compared with the protected specific technologies (e.g. functional ingredients) in which a company controls the use of this technology completely with legally binding limits to use and presentation to the consumer. The generic acceptance of a new range of specific applications can be prejudiced by poor performance or safety issues concerning one of the applications. Obvious but needs addressing.

iii. Performance criteria and indicators: The establishment of a synchronized process assessment including the development of process performance criteria or indicators can be identified as a main research need. A re-evaluation of product-specifications and analytical means may be required in order to adapt them to the requirements of novel products. The lack of information on inactivation kinetics and reaction mechanisms of nutrients, toxins, allergens,
microbes and viruses, shelf-life studies, epidemiological studies, effects on digestibility, on allergens, phytochemicals and melanoidins clearly indicates further research needs regarding emerging food processing technologies but also regarding traditional food processing.

iv. Translation of consumer perception: The development of manageable industrial scale technologies in order to translate the consumer perception into innovative products will be a key step for the further successful development and integration of emerging technologies. Scientists and technologists but also public policy makers with both converging as well as diverging views need to become more aware of societal perspectives and both understand and address these throughout their work; proper, balanced communication on the risks and benefits.

3.6 Food safety governance

Since the publication of the White Paper on Food Safety in 2000 (ec.europa.eu/dgs/health_consumer/library/pub/pub06_en.pdf) all legislation relevant to Food Safety has been in the form of Regulation. This implies the direct incorporation of the EU legislation into the legal systems of the member states. The capacity of individual member states to implement and apply this legislation varies considerably for a number of reasons. The EC polices this via the Food And Veterinary Office (FVO [ec.europa.eu/food/fvo/index_en.cfm]) and this policing is highly transparent – with all relevant reports and replies being published in web form. The variation of the application of legislation will thus tend to diminish over time but some will undeniably permanence, including that which is culturally embedded. Certain generic, transparency issues can be described in the transparency map below (Fig. 10).

The widespread application of HACCP principles (as demanded in the EC regulation 852 [ec.europa.eu/food/food/biosafety/hygienelegislation/comm_rules_en.htm]) provides an example of how national bodies (Competent Authorities) are required to “fill-in” details which the legislation purposefully leaves out. The type of information which might need to be determined at a local level, is described for this example in the white text box at the upper left hand corner of the diagram. These differences in specific levels of stringency and detail take on a particular importance when the food in question follows the traditional supply chain and reaches the consumer without passing through one of the modern large-scale producer brand or supermarket brand (see 3.1 above). In numerical terms the relative capacity of any member state to successfully implement the new (and new style) legislation is possible to determine – the numbers of staff at the various levels in the relevant functions are verifiable. As has been mentioned above, formal evaluations of the capacity and actual activity of national competent authorities is already evaluated by the FVO albeit with a
Transparency in the Food Chain

remit to assure harmonization via programmed “policing” activities. However, detailed knowledge as to the underlying causes of variation and the effects they might have on intra-EU, cross-border trade still needs to be generated. Variation in stringency and rigor in the application of legislation (Willems et al., 2005) leads to an environment in which is a diminished competitiveness especially for the smaller producer who intends to export within the EU 27 space.

Application of legislation accross EU

Comparison of the performance of inspection and inspection systems across EU27 and how they interact with commercial systems. This is a competence of the FVO but it is performed by sampling and has a policing nature, the underlying issues apparently not known.

Fig. 10: Application of legislation across the EU.

A key research need is driven by the following fact: Safety-driven, brand protection specifications driven by large supermarket chains e.g. BRC, IFS) are very stringent. Safety demands are often in excess of what is legislated and are always non-negotiable. This stringency is passed back down the production and supply chain. Also brand-holding producers often practice their own, non-negotiable schemes with suppliers and co-packers. Though this issue strictly spoken is about quality management, questions of stringency are dealt with and further investigations / development on improvement of transparency is justified.

The following research needs arise related to EU legislation:
i. Detailed comparison of the performance of inspection and inspection systems across EU27 and how they interact with commercial systems. Although a competence of the FVO, it is performed by sampling and has a policing nature, the underlying issues apparently not known in detail.

ii. Stringency of control measures and how they are applied by official and the commercial chain still require further investigation / development particularly as relates to their effects on transparency.

### 3.7 Food in the parallel economy in the EU

As referred to above, there is an inherent variability in the stringency and rigor in the application of legislation across the EU27. Cultural diversity as well as economic differences within the EU add to this variability. These differences emerge in the various faces of ‘parallel economy’ and ‘black economy’ throughout Europe. There is a recognised variation in terms of how the parallel economy is perceived by different groups of citizens and this is most likely to be, at least in part, regionally and nationally influenced. Hence, it is consistent that there will be variability in the possibility of foods being sold via the parallel economy. In addition, and at the other end of the transparency map, there will be a spectrum of degrees of acceptance, by the consumer, of foods being produced and reaching them without passing through the formal economy. Certainly in rural and rurally-influenced communities, food which is “natural” or traditional and locally obtained, is often perceived to be superior to food purchased in the formal economy. On the other hand, in urbanized areas rather than rural communities, ethnical differences in food preparation and in the food service sector (numerous ethnical restaurants serving food prepared according to traditions from all over the world) add considerably to the risks of food safety in parallel economies.

The following transparency maps (Fig. 11 and Fig. 12) were drawn up in order to describe how food safety in the parallel economy within the EU is influenced by the incorporation of uncontrolled ingredients into the formal food systems and how food may reach consumers as uncontrolled.
Transparency in the Food Chain

Food in the parallel economy in the EU - incorporation of uncontrolled ingredients into the formal food system

Capture of data along the chain on: Known hazards (chem / micro) Storage, transport and process parameters which control known hazards (micro / bio / toxins).

What part of the chain is this most likely? Near to the final consumer or further back up the chain? Cultural differences?

Different levels and types of stringency across the EU might lead to the incorporation of uncontrolled material entering the broader food system.

Conversion of compliance records into explicit business messages:
Certificates of compliance and other formal messages.

Comparison of the performance of inspection and inspection systems across EU27 and how they contemplate food has passed through the black economy.

Data

Formalisation / compilation of data on known hazards or parameters:
Transformation into compliance format (GAP, GMP, HACCP registers).

Fig. 11: Food in the parallel economy in the EU – incorporation of uncontrolled ingredients into the formal food system.

Food in the parallel economy in the EU – food reaching the consumer as uncontrolled

Capture of data along the chain on: Known hazards (chem / micro) Storage, transport and process parameters which control known hazards (micro / bio / toxins).

What part of the chain is this most likely? Near to the final consumer or further back up the chain? Cultural differences?

Different levels and types of stringency across the EU might lead to the incorporation of uncontrolled material entering the broader food system.

Conversion of compliance records into explicit business messages:
Certificates of compliance and other formal messages.

Comparison of the performance of inspection and inspection systems across EU27 and how they contemplate food has passed through the black economy and is presented to the consumer as such.

Data

Formalisation / compilation of data on known hazards or parameters:
Transformation into compliance format (GAP, GMP, HACCP registers).

Fig. 12: Food in the parallel economy in the EU – food reaching the consumer as uncontrolled.

The following research needs arise related to parallel economies:
i. Many jobs in retail and foodservice are unskilled and poorly paid and quite often companies find it difficult to attract and maintain staff for certain positions. In some cases, particularly in foodservice, these positions can be critical to food safety. Thus high levels of staff turnover can be a serious impediment to maintaining adequate levels of consumer protection in certain types of business. Further research is necessary in order to define the best ways to solve this problem, e.g. by improving food safety education.

ii. Cultural diversity and economical differences within the EU appear amongst other ways, in the level of ‘black economy’ within the Union. There are interactions with food safety, e.g. in the numerous ethnical restaurants we have in the EU, many of which are small family businesses and usually the owners are not well enough aware of HACCP measures or general hygiene. This is an issue for further research.

iii. Detailed knowledge as to the underlying causes of variation in the stringency (specifications applied) and rigor (efficacy of “policing”) across the EU 27 and the potential effects this has on the capacity of smaller companies to compete in member stated other than their own.

4 Summary and conclusion

The area of food quality and manufacturing plays a central role in the food chain and for the different levels of transparency occurring within. However, when considering the whole food value chain, a greater integration is required between raw material production, processing, food quality, safety, nutrition and sustainability. Research programs need to be more collaborative between disciplines in large research topics.

New analytical and other scientific capacities can identify risks which had previously been unknown. The consequence in the food chain of emergence does vary according to the specifics but there are certain scenarios which would be common for any of the sources of emergence. When food products pass through modern, brand-driven chains the levels of stringency are more harmonized across national borders. This is essentially due to the fact that major brand holders will stipulate key specifications for food safety, often anticipating and / or exceeding legally imposed levels of protection according to current scientific knowledge.

Concerning emerging technologies, the establishment of a synchronized process assessment including the development of process performance criteria or indicators can be identified as a main research need. A re-evaluation of product-specifications and analytical means may be required in order to adapt them to the requirements of novel products.
The consumer as part of the food chain seems to be the weakest point with regard to predictability and susceptibility of control actions to be taken in order to maintain the food quality that was generated along the production chain. Better communication will improve the public image of the food industry and needs to take into account the different levels of education and different levels of required information.
B FOOD QUALITY

ABSTRACT
The chapter presents an analysis of the current situation with regard to the availability and transfer of food quality related information along the production chain. Food quality parameters are determined and related impact factors are discussed. Approaches concerning the enhancement of the information flow and quality controls along the food chain are elucidated and evaluated. Aspects of the current knowledge on food quality as affected by traditional and emerging food processing technologies and the existing gaps in research will be pointed out. Finally, deficiencies that have been identified regarding food quality aspects in the food chain are summarized with a focus on food chain complexity and emerging risks as well as analytical methods and food processing considering communication issues and consumer information needs.

1 Determination of food quality parameters of selected products according to sensorial and nutritional quality definitions

Food quality is a crucial success factor in order to maintain high standard products. An appropriate transparency is a key success factor for the ability of the food chain actors to guarantee a maximum level of food quality since the food production chain is complex and consists of multiple single steps from the raw material production up to the final product distribution by retailers. Furthermore, the complexity in the food sector derives from the great variety of food products and processes as well as the numerous regulations regarding food quality. Due to the fact that the food production is not dominated by a few global corporations but by a multitude of SMEs, another level of complexity is based on organizational particularities of the food sector including cultural diversity.

Food quality is a product inherent food property. Apart from the final end-product quality, the assurance of certain quality requirements for raw materials and semi‐finished goods is the key requisite for achieving maximum end‐product qualities within a multi‐step production process. The availability and transfer of quality related information within the food chain is therefore directly linked to transparency issues. The generation and transfer of information related to food quality in industry results in appropriate signals which integrate available information and provide a certain message to recipients. The major food quality related information can be summarized in some categories including such as chemical and nutritional product composition, sensorial and physiological characteristics, the production process as well as raw materials status, contaminants, microbiological quality and food packaging.

The interests of consumers are mainly focused on the food quality characteristics of the final product for assuring constant product specific properties. However, the food sector needs to serve interests in products and processes including information items that can not be directly identified based on final product evaluation such as type of animal feed in milk or meat
production as well as particularities deriving from the location of production. It is the objective of the following section to analyse the current situation on the availability and transfer of food quality related information along the production chain. It is focused on the determination of food quality parameters in general and with regard to main product categories such as fresh cut fruits and vegetables, meat or beverages taking into account sensorial and nutritional quality characteristics. Different steps of the processing chain are evaluated with regard to their impact on food quality.

1.1. Food quality

Quality may be considered as a set of specifications which are to be met within given tolerances or limits. The overall quality of a product should be analysed for its component attributes, each of which should be measured and controlled independently. Quality can then be defined as the composite of those characteristics that determine the degree of acceptability by the user. There are diverse factors along the food chain, which have an impact on food quality in terms of sensorial, chemical/nutritional, physiological and microbiological properties. Since food manufacturers rely on multi-source ingredients from distant points, additional concepts are required in order to control food quality. Different processing methods as well as rapid distribution through complicated marketing channels even increase the complexity. The most accurate measurement of food quality of the finished product will not change its quality to the desirable level. It is therefore necessary to know step by step during the entire manufacturing process how closely specifications are met and which options for their control and correction can be applied. To a certain extent, the quality of the finished product can be predicted by the quality of the raw material already. Figure 1 gives an overview on quality attributes and their role in the food production chain.

![Fig. 1. Quality attributes and their role in food production. Source: Luning et al. (2002).](image-url)
decomposition of food quality attributes. For instance, colour as a food quality attribute is a result of the presence of e.g. carotenoids but also the Maillard reaction compounds. Therefore, the concentration of carotenoids or of melanoidins can serve as a quality performance indicator. These performance indicators are measurable and controllable when food passes through the food chain and appropriate processes can be designed to realise the targeted quality function.

In order to maintain or improve the quality of a process or product, quality management functions involving documentation, measurement and analysis of a system are applied. Figure 2 gives a general schematic depiction on the changes of quality attributes and quality performance indicators of food when it passes along the chain. Depending on processing conditions, product composition or appearance may be modified and hence quality attributes will change. Ideally, one should be able to predict product properties and quality attributes on the basis of food composition and processing.

![Fig. 2: Change in quality attributes of a product passing through the food chain. Source: van Boekel (2005).](image)

1.2 Impact factors on food quality

Product specifications contain relevant food quality characteristics as well as information on how to achieve the desired results. These specifications consider the required raw materials, processing aids, manufacturing conditions as well as finished product attributes. Hence, they are a collection of food quality impact factors. The control of product specifications and food quality requirements is based on the definition of the method of analysis, the frequency of testing as well as the description of the action to be taken if the item is out of spec and only approved methods of analysis should be used for this purpose. Specifications can be documented for raw materials, control points in the manufacturing process as well as the finished product.
Laboratory reports and production records can be used later on for tracing back in case of any complaints from a customer. Considering the whole food chain from acquiring the raw materials, converting them into products and delivering them to the customer, the different steps for product modification and quality changes are numerous. In addition to the flow of goods, a flow of information up- and downstream the food chain takes place and provides quality related criteria. Three major domains such as the primary production, the food technology and the food market can be defined and food quality is a result of all of them to a different extent depending on the type of product (Table 1).

Quality perceptions of various actors in the food chain may be different. Whereas yield or disease resistance may be of a certain interest on the farm side, the consumer may be against the use of agrochemicals or wants unprocessed products whereas the food industry needs to apply certain processing steps in order to deliver products with a long shelf life. Another characteristic of the food industry is the presence of many suppliers. This together with the raw material variations due to growth, storage and processing may result in varying quality of products.

Final quality characteristics of a product such as taste, healthiness or convenience are the ones directly evaluated by the consumer. A consumer does not analyse all elements of food quality, rather he gives an integrated response based on complex judgements made in the mind.

From an industry point of view, increase in food sales has to be achieved by increasing the food quality such as improving the nutritional value, the taste or the convenience rather than lowering the price. This approach requires changes in capacities and structure of a company as well as in the company culture. Consumer orientation is therefore a must in product and process development and procedures such as ‘Open Innovation’ have been created by some large companies.

<table>
<thead>
<tr>
<th>Animal products</th>
<th>Primary production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeding factors</td>
<td>Transport factors</td>
</tr>
<tr>
<td>breed choice</td>
<td>stress of animals</td>
</tr>
<tr>
<td>animal feeding</td>
<td>hygienic conditions</td>
</tr>
<tr>
<td>animal health</td>
<td>travel conditions</td>
</tr>
<tr>
<td>housing condition</td>
<td></td>
</tr>
<tr>
<td>Plant products</td>
<td></td>
</tr>
<tr>
<td>Preharvest factors</td>
<td>Harvesting factors</td>
</tr>
<tr>
<td>cultivar</td>
<td>maturity</td>
</tr>
<tr>
<td>climate conditions</td>
<td>harvest method</td>
</tr>
<tr>
<td>cultural practice (soil, fertilizer)</td>
<td>type of packing</td>
</tr>
<tr>
<td>Preprocessing preparation</td>
<td>Food Processing</td>
</tr>
</tbody>
</table>

Table 1. Food quality parameters in primary production, processing, distribution and storage
1.3 Food quality related domains of transparency

The following domains of transparency have been defined with regard to food quality aspects.

- **Raw material production** (e.g. cultivar, quality categories, genetic modifications, application of pesticides, microbial status)
- **Storage conditions** (e.g. temperature monitoring)
- **Food processing methods** (e.g. traditional vs. emerging technologies)
- **Food composition** (e.g. content of high value ingredients, food additives or allergens)
- **Analytical methods** (e.g. availability, accuracy and limitations, detection limits)
- **Food packaging and distribution** (e.g. active and intelligent packaging, product-packaging interactions, microbial recontamination)
- **Management systems** (e.g. ISO 9000, ISO 22000)
- **Certification systems** (e.g. IFS, BRC)
- **Monitoring schemes** (e.g. official food surveillance)

Considered are the different steps of the production chain as well as framework conditions such as management and certification schemes. The term ‘transparency’ was used in this context since each domain deals with the availability, collection and the transfer of information. The different processing domains consist of complex steps and multiple interactions occur between the flow or raw material, the processing as well as the data collection and quality management as shown exemplarily in Table 2 for the processing of apple juice.
## Table 2.
Food quality related domains for transparency in the production of apple juice

<table>
<thead>
<tr>
<th>Domain of transparency</th>
<th>Parameter</th>
<th>Analytical method</th>
<th>Quality impact on ...</th>
<th>Visibility for the consumer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>variety</td>
<td>morphology, color, texture, taste</td>
<td>flavour, storage stability composition sugar-acid ratio turbidity off flavour, ethanol formation, mycotoxins (Patulin)</td>
<td>variety eventually indicated on package, composition partly detectable via taste</td>
</tr>
<tr>
<td></td>
<td>degree of ripeness</td>
<td>composition, starch content, texture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sugar, acidity, starch</td>
<td>colony count monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>microbial status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>controlled atmosphere (CA)</td>
<td>temperature, humidity, air composition, time</td>
<td>ripening, loss of flavour, moisture, texture, microbial spoilage, degradation kinetics</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>ultra low oxygen (ULO)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food processing</td>
<td>grinding/oxidation</td>
<td>degree of browning, juice turbidity</td>
<td>colour, oxidation of bioactives juice yield, cloud stability pectin extraction from pomace</td>
<td>partly indicated on package</td>
</tr>
<tr>
<td></td>
<td>mash maceration</td>
<td>pectin degradation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>addition of antioxidants</td>
<td>ascorbic acid content</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>separation/filtration fining</td>
<td>cloud, pectin and starch content</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>pasteurisation</td>
<td>microbial status, Maillard compounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food composition</td>
<td>total soluble solids, insoluble solids, colour, sugar-acid ratio, vitamin content, colour index,</td>
<td>Association of the Industry of Juices and Nectars from Fruits and Vegetables of the EU, Code of Practice</td>
<td>appearance, taste, flavour, nutritional value</td>
<td>indicated on package</td>
</tr>
</tbody>
</table>
Table 2. (continuation)  
Food quality related domains for transparency in the production of apple juice

<table>
<thead>
<tr>
<th>Analytical methods</th>
<th>raw material composition, raw material texture, juice composition</th>
<th>intercomparison programmes</th>
<th>validated analysis to meet specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food packaging</td>
<td>type of packaging material, migration, barrier towards oxygen, food-packaging interactions, diffusion properties</td>
<td>storage &amp; migration tests (GM; SML)</td>
<td>shelf life, sensorial &amp; microbial quality, contamination, quality degradation</td>
</tr>
<tr>
<td>Management system</td>
<td>ISO 9000, ISO 22000 implementation, maintenance, certification body</td>
<td>auditing</td>
<td>verification, maintenance</td>
</tr>
<tr>
<td>Certification systems</td>
<td>IFS, BRC, implementation, maintenance, integrity of the standard, certification body score</td>
<td>auditing</td>
<td>verification, maintenance</td>
</tr>
<tr>
<td>Monitoring systems</td>
<td>food inspection, maintenance</td>
<td>auditing</td>
<td>verification, maintenance</td>
</tr>
</tbody>
</table>

1.4 Summary
The analysis of food quality along the production chain emphasized its outstanding importance as one key food characteristic. From a consumer point of view, quality perception is reduced to a few properties mainly referring to appearance, taste, healthiness and convenience which are evaluated under consideration of the price of the food. On the other hand, consumer trust in food products and especially in branded foods contributes to a large extent to a certain quality perception which does not require any further communication.
Considering the left end of the production chain, namely the raw material supply, it was shown that this part is providing the basis for the production of high quality food in subsequent steps of the chain. The multi-step nature of the food chain as well as the complex interactions between and within the different steps represent the most challenging issue when it comes to the transfer of food quality information along the chain.
Even though quality attributes or performance indicators are measurable in most cases by analytical means, their correlation to consumer perception as well as the selection of relevant aspects to be transferred further is required. On the other hand, some analytical methods
applied today are still based on principles that become less appropriate since new complex product formulations are on the market. Therefore, the revision of traditional quality specifications with regard to current needs is one of the key tasks for future food quality development.

A large number of specifications, management and certification schemes are available for the different food product categories. However, in order to increase the efficiency of quality management, a further reduction and harmonisation seems still appropriate. The consumer as part of the food chain is still of key importance with regard to predictability and susceptibility of control actions to be taken in order to maintain the food quality that was generated along the production chain up to this point.

2 Analysis, evaluation, and documentation of selected ‘best practice’ monitoring and reporting schemes

As it has been shown in the previous section, the raw material supply is providing the basis for the production of high quality food in subsequent steps of the chain. In addition, food quality depends on a great variety of influence factors, starting from the maintenance of several food hygiene concepts, regulations, laws and the implementation of an appropriate quality management system to the assurance of certain quality requirements. Food quality is a product inherent food property and a key success factor in order to maintain high standard products. Furthermore, the consumer’s buying decision depends greatly on it. The multi-step nature of the food chain as well as the complex interactions between and within the different steps represents the most challenging issue when it comes to the transfer of food quality information along the chain.

Another challenging part represents the type, quantity and reliability of food quality controls. Since especially microbiological examinations are time-consuming and cost-intensive, new rapid, cost effective and preferably non-destructive techniques are needed. Additionally, some analytical methods applied today are still based on principles that become less appropriate since new complex product formulations are on the market. Therefore, the revision of traditional quality specifications regarding the current needs is one of the key tasks for future food quality development. Quality controls are carried out on the basis of sensory, chemical, physical and microbiological properties. For perishable foods, the storage as well as the transport conditions are of utmost importance. In particular, the temperature has a significant influence on the freshness and shelf-life of such products. The more gapless the monitoring of these parameters is and the more controls are conducted, the more solid the basis for producing high quality products is.

In the following section, two new approaches concerning the enhancement of the information flow and quality controls along the food chain are elucidated and evaluated. With regard to these issues, RFID technique will be discussed as best practice examples and as a tool for the recording and transfer of quality related information of perishable products. Exemplarily a handheld device for quality determination of fresh pork meat will be discussed, which could be a
possible solution to improve the transparency within the meat chain.

2.1 RFID techniques for quality determination of harvested perishable products

Fresh fruits and vegetables are limited in shelf life after harvest even under optimal storage conditions. The storage temperature plays a major role in order to maintain food quality and safety especially for these products. Higher temperatures accelerate the loss of important components. Lower air humidity and strong air movement lead to unwanted wilting. High air humidity in connection with high temperature supports microbial growth and causes thus faster deterioration of the product. All these parameters can be controlled at certain steps of the transport chain, but the transfer of information in between these steps is missing since documentation is incomplete or the stakeholders are unwilling to share information.

Recently, increased importance is put on the information flow either as need raised from governments and retailers in order to deal with safety issues, or as a need of the retailers to improve performance across their supply chains. These latest developments in the industry have indicated a need for closing the information gap between food supply chain members, by creating common information and data sharing strategies.

One of the promising strategies represents the use of small technological units which can be fixed on the packaging. Active transponders, which have approximately the dimensions of a credit card, measure temperatures in selectable intervals and store the obtained data. Similarly to price scanner systems additional information about the product (e.g. origin, harvest date etc.) can be saved on the transponder card by certain write/read units. Active transponders operate like complete, simply arranged data logger with analogue input for temperature measurement. These RFID-techniques (Radio Frequency Identification) are used to determine temperature as well as time and air humidity related quality changes along the post harvest chain of perishable food products. A programmable temperature logger can identify problems incurred with produce during cold chain storage and transit, thus providing an improved quality control system for food manufacturers.

Quality relevant parameters of fresh fruits and vegetables include the pre-harvest conditions, the date of harvesting, the cultivar and the origin as well as storage parameters like the temperature and air humidity. Particularly the time, temperature and air humidity are of importance concerning the quality of fresh fruits and vegetables. Extended storage times, interruptions in the cool chain or inappropriate air humidity lead to quality losses and decrease the shelf life of perishable foods. Thus, the transfer of information concerning these parameters along the food chain is of big interest.

The producer represents the beginning of the chain. He is mainly responsible for the cultivation and harvesting of the commodity. The fertilization, irrigation, plant protection and an ideal harvesting date are the substantial basis for a high quality product. By storing this information on RFID transponders, all the following steps of the food chain are provided with it (Fig. 3). To monitor the time, temperature and humidity conditions continuously, the transponders are usually fixed on containers, pallets or boxes. By the use of an RFID reader, the farm cooperative
is now able to readout all collected information to ensure the good’s properness. Also here the RFID transponder is continuously recording information concerning storage parameters, packaging and the common time, temperature and humidity conditions.

During the next steps in the chain – Wholesale, Retail and Consumer – these parameters have priority as well. In the case of an emergency, all charges of an affected product can be easily identified, traced back to their origin and withdrawn from circulation very fast. Products, which were not transported properly don’t get into retail stores.

![Temperature profile of fresh cut lettuce at different steps of the production chain](image)

**Fig. 3**: Temperature profile of fresh cut lettuce at different steps of the production chain obtained by RFID temperature mapping. Source: Schlueter (2010).

Main interest of the actors along the post-harvest chain from producer to consumer is to know at which stage (producer, transport, wholesale, transport, retail) important quality losses arise, so that effective counter measures can be seized. The demand for comprehensive traceability along the value-added chain is growing, especially within the particular sensitive segment of food production. The presently available transponder systems to track the production chain are limited in data transition distance due to high amounts of water in the produce. The performance parameters must be extended and improved.

RFID transponders are recommended for recording e.g. temperatures during transportation and/or storage of temperature-sensitive goods such as fresh or frozen food. Additionally, they allow time as well as humidity monitoring along the supply chain by applying a cost effective solution. Then transfer of recorded data is easily possible between different steps of the production/transportation chain. It is therefore possible, to estimate product quality to a certain extent based on the obtained profiles.

To handle the obtained information further adaptation (also for product similarity) will be necessary since their structure along the post-harvest chain is not uniform and relevant participants partly pursue opposite objectives. Beside the application for fresh marketed
products, various other practical applications of the active label sensors are conceivable in fruit and vegetable processing for instance in processing of convenience products as ready to eat salads etc.

An efficient qualitative traceability system like RFID does not improve product safety, neither its quality per se. The role of such a system is to assure the information flow along the production chain, and finally to assist in assuring consumers health and safety as well as the maintenance of high quality levels by enabling rapid recall and withdrawal of hazardous products.

2.2 Fluorescens spectroscopy for quality determination of fresh pork meat

From a nutritional and a sanitary point of view, a high degree of food quality and safety is essential for food producers, consumers and the food surveillance as well as for the food science. Since only a short interruption of the cool chain leads to a high decrease in shelf life, especially perishable products like raw meat require a forceful monitoring.

Therefore, besides the mandatory self-inspections of the industry, the official food surveillance undertakes checks on firms. The quantity of these checks is mainly related to the potential risk concerning the processed food. In 2007, nearly half of the 1 187 335 German companies were inspected and over 21 % of 70 145 analyzed samples of the scope “meat and meat products” violated the law. So these products belonged to the most critical of all scopes.

In food industry, samples are examined with the help of sensorial, physical, chemical and microbiological methods, which are mostly time-consuming and cost-intensive. This issue and the fact, that especially microbial contaminations cause serious risks for the consumer, made it necessary to develop a gapless and production-wide food quality monitoring system.

Thus, a rapid availability of characteristic product data as well as their dissemination along the whole food chain is needed. Supplying these data at each critical point of the chain enables the stakeholders to undertake well-directed actions in terms of quality enhancements.

For that purpose, devices for a rapid quality analysis need to be developed. One examples is the ‘FreshScan’ system, an optical handheld device, which allows a rapid determination of meat quality.

The handheld scanner is based on fluorescence spectroscopy, which has a strong potential for meat inspection. In order to determine meat quality parameters, the device has to be placed directly on the meat surface. The integrated light source emits light with a wavelength of 420 nm, which hits the meat surface and excites both, protoporphyrin IX (PPIX) and zinc protoporphyrin (ZnPP). The fluorescence intensity of protoporphyrin IX and zinc protoporphyrin increases during ageing of fresh pork meat. Signals are correlating well with both storage time and temperature and consequently the selective detection could therefore be used for time-temperature-indication of the state of ageing of fresh pork meat (Schneider, Wulf et al. 2008).

After the slaughtering process, the carcasses are usually loaded and transported to a meat cutting plant. Before loading the carcasses, the meat quality has to be determined to have an initial data record which is transferred to a logistics logger (wireless, 13.56 MHz, ISO 14443). The complete product cycle data is stored on both, on the logistics logger and in a database, which is
used to compare the measured data with reference data. The quality determination can be subsequently done before and after each step of the chain. The continuous collection of quality data by the use of the logistics logger provides traceability (Fig. 4). The system could also be used in retail stores as well as at the consumer’s site. Even already packed meat, which can be found in self-service areas, could be observed using the ability to perform the measurement just through the packaging.

![Diagram of FreshScan equipped pork meat chain](image)

**Fig. 4:** Flow chart of a FreshScan equipped pork meat chain.

### 2.3 Summary

The above discussed examples, the RFID system as well as the FreshScan device, showed, that the development and implementation of new technologies could lead to an increase of transparency in the food chain. With the help of RFID-techniques, especially the flow of information along the chain could be fundamentally improved. The continuously recorded data provides cross-stage traceability and ensures a gapless monitoring of quality related parameters. In particular complex supply chains could be monitored more efficient, precise and extensive. The fast and easy access to the stored data would be a major contribution towards an improved transparency. The FreshScan system is, in contrast to traditional time-consuming examinations, fast and uncomplicated. Its ability to measure meat quality parameters contactless and just in seconds at
each step of the chain makes it very promising, especially in combination with appropriate RFID loggers and databases.

Both best practice examples are important tools on the way to an enhanced transparency. Further developments are necessary in order to open new application areas and to reduce costs as well as to achieve a maximum level of transparency.

3 Analysis of deficiencies (weaknesses) within traditional food processing, of improvement opportunities through process optimization or emerging technologies, and of feasibility regarding industrial implementation

Benefits of traditional thermal food processing include aspects such as the inactivation of food-borne pathogens, natural toxins or other detrimental constituents. Inactivation of microorganisms and enzymes results in the prolongation of shelf-life. Thermal processing may improve digestibility and bioavailability of nutrients, palatability, taste, texture and flavor.

On the other hand, thermal processing can bring some unintentional undesired consequences, such as losses of certain nutrients, formation of toxic compounds (acrylamide, furan or acrolein), or of compounds with negative effects on flavour perception, texture or color.

Therefore, the heat treatment of foods needs to be optimized in order to promote beneficial effects and to counteract, to the best possible, undesired effects. The application of non-thermal technologies for food preservation such as isostatic pressure, pulsed electric fields or cold plasma is seen to have the potential to replace or complement traditional food processing by reducing the negative impacts of thermal food processing.

In each case, the main task is to ensure the safety and quality of food while ensuring consumer acceptability as occurs during industrial food processing and during household cooking. Consumer perception of (mainly industrial) food processing is rather negative, probably due to the large attention to formation of undesired compounds, but clearly processing also leads to the formation of compounds with beneficial properties. Moreover, industrial processing (using traditional or emerging technologies) can be controlled and optimized much better through the application of kinetic principles than household cooking.

This section will address some aspects of the current knowledge on food quality and safety as affected by traditional and emerging food processing and the existing gaps in research will be identified.

3.1 Overview of food processing technologies

Quality changes of food are due to changes at the chemical, biochemical, physical and microbial levels. For example, the nutritional value of a product may change because of oxidation of a vitamin (chemical reaction), the color of a food may change because of enzymatic conversion of polyphenols (biochemical reaction), phase changes may occur in food (physical reaction) and foods may spoil because of bacteria or moulds (microbial reaction). Depending on the food processing technology applied and on the resulting shelf life, quality changes may be more or less pronounced. Table 3 gives an overview of advantages and disadvantages of food processing
technologies.

Table 3. Overview of food processing using thermal and non-thermal technologies and their impact on food quality and safety

<table>
<thead>
<tr>
<th>Process</th>
<th>Advantage</th>
<th>Disadvantage</th>
<th>Conditions</th>
<th>Comments</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>Nutritional value largely maintained</td>
<td>Formation of undesired compounds, (e.g. acrylamide)</td>
<td>Pasteurization: 70 – 100 °C</td>
<td>Inactivation of vegetative cells and spores (sterilization)</td>
<td>(Kessler 2002)</td>
</tr>
<tr>
<td></td>
<td>Inactivation of anti-nutritional factors achieved (e.g. trypsin inhibitors) and some allergens</td>
<td>Loss of freshness and related sensory attributes</td>
<td>Sterilization: 110-150 °C</td>
<td>Formation of desired flavour and texture (e.g. Maillard reaction)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inactivation of enzymes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sensory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ease of use for industry and household processing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In general cost effective</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Pressure</td>
<td>No formation of undesired compounds</td>
<td>Desirable flavour compounds generated by heat are not formed</td>
<td>Pasteurization: 600 MPa, ambient temperature (batch process)</td>
<td>Inactivation of vegetative microorganisms and spores (PATS)</td>
<td>(Hendrickx and Knorr 2001)</td>
</tr>
<tr>
<td></td>
<td>Nutritional value largely maintained</td>
<td></td>
<td>Sterilization: 600 MPa, 121.1 °C rapid, homogenous heating and cooling due to adiabatic heating (batch process)</td>
<td>Possible inactivation of enzymes, viruses and prions (p,T – dependent)</td>
<td>(Doona and Feeherry 2007)</td>
</tr>
<tr>
<td></td>
<td>Retention of freshness</td>
<td></td>
<td></td>
<td>Treatment of packaged food</td>
<td>(Mathys, Reineke et al. 2009)</td>
</tr>
<tr>
<td></td>
<td>Physical modification</td>
<td></td>
<td></td>
<td>Cold storage (4 °C) or storage at ambient temperature</td>
<td></td>
</tr>
<tr>
<td>Pulsed electric field</td>
<td>No formation of undesired compounds</td>
<td>Spores are not inactivated</td>
<td>Cell disintegration: 1-5 kV/cm 1-10 kJ/kg</td>
<td>Intensity dependent occurrence of electrochemical and thermal side effects</td>
<td>(Vorobiev and Lebovka 2008)</td>
</tr>
<tr>
<td></td>
<td>Gentle processing, retention of freshness</td>
<td>Desirable flavour compounds generated by heat are not formed</td>
<td>Non-thermal pasteurization: 25-40 kV/cm 50-200 kJ/kg</td>
<td>Refrigerated storage of products required</td>
<td>(Raso and Heinz 2007)</td>
</tr>
<tr>
<td></td>
<td>Cell disintegration</td>
<td>Inactivation of anti-nutritional factors not achieved</td>
<td>Short processing times Continuous operation</td>
<td></td>
<td>(Lelieveld, Notermans et al. 2007)</td>
</tr>
<tr>
<td></td>
<td>Improvement of mass transfer processes</td>
<td>No inactivation of enzymes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Physical modification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Membrane processing</td>
<td>No formation of undesired compounds</td>
<td>Desirable flavour compounds generated by heat are not formed</td>
<td></td>
<td>Only applicable for liquids</td>
<td>(Pabby, Rizvi et al. 2008)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inactivation of anti-nutritional factors not achieved</td>
<td></td>
<td>Expensive for complex products</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Added value for separation of ingredients</td>
<td></td>
</tr>
<tr>
<td>Dehydration processes</td>
<td>Preservation</td>
<td>No inactivation of microbes and anti-nutritional factors</td>
<td>Sublimation drying (freeze drying): -10 to -40 °C 0.01-1 mbar</td>
<td></td>
<td>(Chen and Mujumdar 2008)</td>
</tr>
<tr>
<td></td>
<td>Reduced reaction rates</td>
<td>Formation of heat</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 3.2 Thermal processing

Thermal treatment of foodstuffs induces several biological, physical and chemical modifications, leading to sensory, nutritional and textural changes. In most cases, the thermal treatment of foods results in enhanced food safety and quality. The application of heat during food processing encompasses a variety of processes, such as boiling, frying, steaming, baking, stewing and roasting, toasting, kilning, roasting, drying processes, canning, pasteurization and related technology (ultra high temperature treatment) smoking and extrusion cooking.

The quality of food, from the nutritional, microbial safety point of view and sensory aspects depends on a range of variables from farm to fork, including the quality of the raw material, processing techniques, packaging and cooking. An important effect of food processing in most cases is the destruction of unwanted compounds and microorganisms.

The minimal heat treatment in this respect is pasteurization which comprises a time–temperature combination. Provided that the food is properly packed so that no recontamination occurs and it is stored refrigerated, pasteurized food is generally safe from a microbiological point of view. A more intense heat treatment is sterilization in which not only vegetative cells but also spores are inactivated. If properly packed and if recontamination is prevented, such foods are completely safe from a microbiological point of view. However, the quality of sterilized foods will diminish over time because of chemical changes taking place in the food.

Another effect of heat treatment is the inactivation of anti-nutritional factors such as protease inhibitors (e.g. trypsin inhibitors in soy) and other natural toxins (Van Boekel, Fogliano et al. 2010). Table 4 summarizes some of the beneficial and negative effects of thermal food processing.

<table>
<thead>
<tr>
<th>Process</th>
<th>Benefits</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freezing</strong></td>
<td>Reduced reaction rates</td>
<td>Cold air freezing: 30 °C to -50°C</td>
</tr>
<tr>
<td></td>
<td>No formation of undesired compounds</td>
<td>Contact freezing: approx. -40°C</td>
</tr>
<tr>
<td></td>
<td>Retention of freshness and nutrients (e.g., vitamins)</td>
<td>Cryogenic freezers: -40°C to -196 °C</td>
</tr>
<tr>
<td></td>
<td>Reduced reaction rates</td>
<td>Applicable to almost all foods</td>
</tr>
<tr>
<td></td>
<td>No inactivation of pathogens, and anti-nutritional factors</td>
<td>Industrial freezing can be precisely controlled</td>
</tr>
<tr>
<td></td>
<td>No inactivation of enzymes</td>
<td>Frozen storage at -20°C</td>
</tr>
<tr>
<td></td>
<td>Loss of structure</td>
<td>(Mallett 1993)</td>
</tr>
</tbody>
</table>

(Hui 2008)
3.3 Non-thermal processing

The development of emerging technologies in food processing addresses specific consumer needs towards safe, healthy and minimally processed foods. At the same time, these innovative processes lead to environmentally friendly and sustainable food manufacturing techniques with low energy requirements and reduced water use that overcome some limitations given by current food processing practices (Toepfl, Mathys et al. 2006). Taking advantage of specific potentials and opportunities of these new processes including the understanding and control of the complex process-structure-function relationships offers the possibility for a science based development of tailor made foods.

**Pulsed electric fields (PEF)**

When exposed to high electric field pulses cell membranes develop pores which may be permanent or temporary, depending on the intensity and treatment conditions (Zimmermann, Pilwat et al. 1974; Angersbach, Heinz et al. 2000). An irreversible perforation of the cell membrane reduces its barrier effect permanently and causes cell death which can be applied for plant and animal raw material disintegration (Angersbach and Knorr 1998; Toepfl and Heinz 2007) as well as for the non-thermal inactivation of microorganisms (Lelieveld, Notermans et al. 2007).

Pulsed electric field processing consists of the application of very short electric pulses (1-100 µs) at electric field intensities in the range of 0.1-1 kV/cm (reversible permeabilisation for stress induction in plant cells), 0.5-3 kV/cm (irreversible permeabilisation of plant and animal tissue) and 15-40 kV/cm for the irreversible permeabilisation of microbial cells. Generally, high intensity electric pulses can be generated by the switched discharge of a suitable capacitor bank. The characteristics of the discharge circuit determine the shape of the time dependent potential at the treatment chamber where the product is exposed to the electric field (Barsotti, Merle et al. 1999).

<table>
<thead>
<tr>
<th>Beneficial effects</th>
<th>Negative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food safety (pathogens): The main benefit of food processing is inactivation of</td>
<td>losses of certain (essential) nutrients (e.g. vitamin C, available lysine)</td>
</tr>
<tr>
<td>food-borne pathogens, as is normally required by Food Safety Legislation</td>
<td></td>
</tr>
<tr>
<td>Food safety (other aspects): inactivation of natural toxins and enzymes,</td>
<td>formation of undesired compounds, e.g. acrylamide, acrolein</td>
</tr>
<tr>
<td>prolongation of shelf-life</td>
<td>chloropropanediols and –esters, heterocyclic amines, etc.</td>
</tr>
<tr>
<td>Nutritional value: improved digestibility, bioavailability of nutrients</td>
<td>in some cases, formation of compounds that have a negative</td>
</tr>
<tr>
<td></td>
<td>effect on flavour perception (for instance, sulphur compounds</td>
</tr>
<tr>
<td></td>
<td>formed during heating of milk</td>
</tr>
<tr>
<td>Sensory quality: taste, texture and flavour</td>
<td>loss of texture, discolouration, etc.</td>
</tr>
<tr>
<td>Functional health benefits: e.g. probiotics, prebiotics, Maillard reaction products</td>
<td></td>
</tr>
<tr>
<td>(MRPs), flavonoids, other food constituents and their reaction products</td>
<td></td>
</tr>
<tr>
<td>Convenience: availability of ready-to-eat and semiprepared foods, e.g.</td>
<td></td>
</tr>
<tr>
<td>microwavable frozen meals</td>
<td></td>
</tr>
<tr>
<td>Cost: economy of scale</td>
<td></td>
</tr>
<tr>
<td>Diversity: independence from the seasonal availability of foods, and introduction</td>
<td></td>
</tr>
<tr>
<td>of global food supply chain</td>
<td></td>
</tr>
<tr>
<td>Quality of life: improved because less time required for food</td>
<td></td>
</tr>
<tr>
<td>supply and preparation</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.

Beneficial and negative effects of thermal food processing
PEF technology is on the verge of industrial application with various pilot scale units available worldwide (Raso and Heinz 2006; Lelieveld, Notermans et al. 2007). The irreversible rupture of plant membranes offers various applications to replace or support conventional thermal as well as enzymatic processes for cell disintegration (Vorobiev and Lebovka 2008). Irreversible permeabilization allows significant improvement of mass transfer especially for drying, expression, concentration and extraction resulting into higher product yields, shorter processing times and consequently reduced energy consumption (Toepfl, Mathys et al. 2006).

The application of PEF for the irreversible cell disintegration of plant an animal raw material was limited by the availability of large scale pulse modulators but a forward looking technical development was already undertaken in the last years in order to overcome production scale limitations. In order to implement the cell disintegration processing step into existing processes, an integrative approach will be required that is considering pre- and post-PEF processing unit operations such as mechanical disintegration of solid-liquid separation in the case of extraction of juice recovery in order to successfully transfer the cell disintegration provided by PEF into improved process results such as higher juice yields. For the PEF assisted pasteurization, the design and optimization of the PEF treatment chamber is the most challenging point with regard to different product properties such as viscosity and electrical conductivity as well as with regard to uniform treatment conditions in terms of electric field and temperature distribution.

High Pressure Processing (HPP)

High pressure treatment of foods involves the application of pressure levels ranging from several tens of MPa in common homogenizers or supercritical fluid extractors to several hundreds MPa in ultra high pressure homogenizers or HP pasteurization units. In addition to the inactivation of microorganisms to enhance the shelf life of the treated food, there are numerous other interesting applications like food structure engineering (Diels and Michiels 2006; Knorr, Heinz et al. 2006; Sharma and Yadav 2008).

Without doubt, the inactivation of vegetative microorganisms to extend the shelf life of food is currently by far the largest commercial application of isostatic HP at an industrial scale. Typical industrial HP units consist of a horizontal HP vessel and an external pressure generating device. The simplest practical system of an intensifier is a single-acting, hydraulically driven pump. (Rovere 2002). For the HP treatment, the packaged food is deposed in a carrier and automatically loaded into the HP vessel and the vessel plugs are closed. The pressure transmitting media, usually water, is pumped into the vessel from one or both sides in order to realize the pressure built up.

HP pasteurization is currently the main application in industrial HP processing. The success of HP treated products is primarily because HP treated foods, in addition to their microbiological safety, retain more of their original fresh taste, texture and nutritional content. These products are consequently products with superior quality compared to their thermal treated counterparts (Patterson, Linton et al. 2007). At present, there is a wide range of HP processed products available, from meat products, fruit juices via seafood to dairy products and ready-to-eat-meals. More than 30% of the total vessel volume is used to process meat products like sliced ham,
Turkey or chicken cuts and ready-to-eat-meals, primarily to inactivate *Listeria* and to increase to shelf-life of the treated product. 34% of the total vessel volume used is utilized to inactivate enzymes (e.g. PPO in avocado based products) and to modify the texture of vegetables and fruits and its related products, like fruit dessert, smoothies or ready-to-eat vegetable dishes. In 13% of the total vessel volume used fruit juices are processed to increase the shelf-life by keeping their sensory quality. Another 14% are used for the pressure treatment of seafood, mainly oysters and shellfish. A further advantage beside an increased shelf-life (destruction of *vibrio vulnificus*) during the treatment of oysters is an easier opening of the oyster shell and improved meat extraction of lobsters and crabs (www.nchyperbaric.com).

HP offers several interesting application in the food industry, for instance HP treated starches have a reduces digestibility and might be used to substitute fat in dietary foods (Sharma, Yadav et al. 2008; Zhang, Sofyan et al. 2008). A further possible application of HP is its combination with temperatures below 0 °C for a sub zero storage of food in the liquid state or a cold denaturation of proteins to form e.g. gel with unique properties.

**Cold Plasma**

Cold plasma (CP) based surface treatments such as ultra-fine cleaning, etching, surface functionalization, thin film deposition and environmental applications such as exhaust air cleaning are proven techniques and already applied using industrial scale plasma systems (Roth 1995; Foest, Kindel et al. 2005). A strong increase of plasma applications in medical device technology and therapeutic medicine is currently taking place including applications such as plasma decontamination and research is focussing on the interaction between plasma and biological cells and tissue as well as on the plasma diagnostics with regard to the understanding and control of the complex behaviour of CP (Weltmann, Kindel et al. 2009; Daeschlein, Woedtke et al. 2010). Similar research work is undertaken in the field of food science in order to explore the potential for CP application in the food industry (Mastwijk and Nierop Groot 2010).

Plasmas can be described as quasineutral particle systems in the form of gaseous or fluid-like mixtures of free electrons and ions, frequently also containing neutral particle (atoms, molecules), with a large mean kinetic energy of the electrons and/or all of the plasma components and a substantial influence of the charge carriers and their electromagnetic interaction on the system properties (Rutscher 2008). Non-thermal plasmas may be produced by a variety of electrical discharges at different pressure levels.

The antimicrobial activity of non-thermal plasma against Gram-negative and Gram-positive bacteria, yeast and fungi, biofilm formers, and endospores was shown in various studies (Kelly-Wintenberg, Hodge et al. 1999; Montie, Kelly-Wintenberg et al. 2000; Laroussi 2005; Vleugels, Shama et al. 2005; Brandenburg, Ehlbeck et al. 2007). Although several reviews focus on the inactivation mechanisms of plasma (Moisan, Barbeau et al. 2001; Boudam, Moisan et al. 2006; Gaunt, Beggs et al. 2006; Moreau, Orange et al. 2008) it is not yet fully understood. Moisan et al. (2001) stated that three basic mechanisms are involved in plasma inactivation: A) UV irradiation of genetic material B) intrinsic photodesorption and C) etching. The role of UV inactivation at atmospheric pressure plasma is controversy discussed in the literature. Most of
the researches claim that UV plays a minor role in the inactivation of microorganisms at atmospheric pressure and the inactivation process is controlled by chemically reactive species. Although much work has already been performed on the effects of non-thermal plasma on microorganisms, information of plasma interaction with food components is rare. This is mainly due to the fact that the application of plasma was long time limited to heat-and vacuum resistant materials. As mentioned before, today plasma can operate at ambient pressure and low processing temperature. The degradation of mycotoxins in microwave-induced atmospheric pressure argon plasma has recently been shown by Park et al. (2007). Plasma treatment resulted in a significant time-dependent decrease in aflatoxin B1, deoxynivalenol and nivalenol coming along with a dose-dependent reduced cytotoxicity. The modification of starch in a glow discharge argon plasma is manifested in a loss of OH groups which is probably due to the cross-linking of \(\alpha\)-D-glucose units (Zou, Liu et al. 2004).

Plasma technologies in food processing are not yet established, but investigations using complex food raw materials have been performed. Some studies focus on the plasma-related decontamination of bacteria at the surface of several fruit and vegetable samples like apples, cantaloupe, lettuce without evaluating the obtained product quality (Niemira and Sites 2008). A possible application of non-thermal plasma is the treatment of packaged products. Schwabedissen et al. (2007) described the different application fields of the PlasmaLabel™, e.g., fresh food conservation or packaged goods. However, further investigations are required to characterize the plasma applied and to better understand the interactions of reactive species with organic surfaces as well as vital bio-systems (Mastwijk and Nierop Groot 2010). Beside the application in food processing, progress in germ reduction technologies is important for medical and biomedical application, biotechnology, the pharmaceutical industry and the packaging industry.

### 3.4 Process assessment of non-thermal technologies and legislative aspects

A comprehensive statement on food safety aspects, process assessment and legislative situation can be found in the Opinion of the Senate Commission on Food Safety (SKLM) of the German Research Foundation (DFG) (Eisenbrand 2005; Knorr, Engel et al. 2008). Some key aspects are discussed below.

The specifications given on the design of different PEF installations and the process parameters used are generally insufficient to obtain reliable information allowing the assessment of literature data. Additionally, in many cases it is not possible to differentiate between electrochemical effects and local thermal effects.

Processing with a pulsed electric field (PEF) is a new method in food technology. PEF-treated food products may only be placed on the market in the European Union (EU), after having examined whether they fall within the scope of Regulation (EC) No.258/97 concerning novel foods and novel food ingredients that came into force on 15th May 1997. To be considered as novel – and thus subject to authorisation according to Article 4 of Regulation (EC) No. 258/97 – are “Foods and food ingredients to which has been applied a production process not currently
used, where that process gives rise to significant changes in the composition or structure of the foods or food ingredients which affect their nutritional value, metabolism or level of undesirable substances.” Placing on the market of high pressure-treated food had already demonstrated the necessity of extensive investigations in order to decide whether the thus-treated products fall within the scope of Regulation (EC) No. 258/97. If the PEF-process leads to significant changes with effects on nutritional value, metabolism or levels of undesirable substances in the food, a safety assessment must be carried out as part of the authorisation procedure in accordance with Regulation (EC) No. 258/97.

High pressure process development has progressed rapidly over the last decades and high pressure treated foodstuffs have been marketed in Japan since 1990 and in Europe and the United States since 1996. Before the Regulation (EC) No 258/97 came into force, high pressure pasteurised orange juice had been placed on the French market. Subsequently, national authorities of the EU member states that are responsible for the enforcement of the Regulation have examined applications for approval or requests regarding the legal status of the following high pressure treated products: fruit preparations (France), cooked ham (Spain), oysters (Great Britain), fruits (Germany). In all cases, it was shown that the high pressure treatment has not caused significant changes in the composition or the structure of the products affecting their nutritional value, metabolism or the amounts of undesirable substances. In France high pressure pasteurised orange juice had already been marketed before Regulation (EC) No 258/97 came into force. In December 1998 the Groupe Danone submitted in accordance with Regulation (EC) No 258/97 an application for the placing on the market of high pressure treated fruit preparations to the French competent authority. Since high pressure treatment had been employed for the pasteurisation of orange juice but not for fruit preparations, the applicant considered the latter as a novel food ingredient in accordance with article 1, paragraph 2 f of Regulation (EC) No 258/97. However, the results of the studies that the applicant provided that the high pressure treatment does not cause no significant changes in the composition or structure of the fruit preparation, which might affect its nutritional value, metabolism or level of undesirable substances. Having examined the dossier, the competent authority, the Agence française de sécurité sanitaire des aliments (AFSSA) arrived at the same conclusion and stated that the high pressure-treated fruit preparations, apart from a higher vitamin content in most cases, did not differ significantly from those that have been thermally pasteurised. The European Commission decided in May 2001 to authorise the placing on the market of the high pressure pasteurised fruit preparations. The competent authorities of the EG-Member States agreed in July 2001, that in future the national authorities should decide on the legal status of high pressure treated foodstuffs on the basis of appropriate data provided by the manufacturer. If the competent authority arrives at the decision, that the product does not fall within the scope of Regulation (EC) No 258/97 and thus can be marketed without approval, the Commission and the other Member States should be informed accordingly. The competent authority of Spain informed in July 2001, that high pressure pasteurised cooked ham, and the British Food Standards Agency in August 2002, that high pressure treated oysters are not
considered novel foods and could therefore be placed on the market without approval. In Germany an application for the examination of the legal status of high pressure preserved fruits was submitted to the then existing Bundesinstitut für Verbraucherschutz und Veterinärmedizin (BgVV). The BgVV came in March 2001 to the decision that the high pressure treatment does not cause significant changes in the composition or the structure of the fruits, which affect their nutritional value, metabolism or level of undesirable substances. The European Commission and the EUMember States were informed accordingly by the BgVV. Direct application of Cold Plasma to foodstuffs that are marketed is not taking place yet. As described earlier, Cold Plasma is used so far only for the modification or disinfection of food packaging materials leading to no direct impact on the packaged food.

3.5 Summary
The translation of consumer perceptions (particularly flavour, texture and the presence of health promoting components) into manageable industrial scale technologies is a major challenge for the food industry and offers a large potential to modern food-processing technology. However, further data on non-thermal processes in terms of inactivation kinetics and reaction mechanisms of nutrients, toxins, allergens, microbes and viruses are required and shelf-life studies of non-thermally treated products are desirable. Up to now, there is a lack of information about the food processing in epidemiological studies. Further study is required to find or synthesize pure standard compounds to enable the conduct of more accurate mechanistic studies and to further identify other bioactive or functional compounds, thus providing stronger evidence of the beneficial or negative effects of food processing including especially the effects of new processing technologies on digestibility, on allergens, phytochemicals and melanoidins. In order to evaluate the relevance of positive or negative impacts for human consumption, a transfer of in vitro to in vivo results is necessary including the establishment of a database in order to estimate the level of intake of compounds from processed foods. The number of substantiated studies is limited in all areas, and a consistent evaluation of the technologies is still hindered due to the lack of standardisation of process parameters. Development of criteria to assess the process or the treated foods requires, among other things, the characterization of suitable indicator substances and measuring parameters in the same way that they have been established for traditional thermal processing already.
At present, the knowledge of the implications of the PEFprocess on different food matrices is insufficient to perform a general safety assessment of the process. Therefore, products or product groups treated by the PEF-process must be assessed on a case-by-case basis. The technical parameters of the PEF-process must be described in a way that a reliable assessment of the product safety of the treated foods is possible. On the one hand, this applies to the process itself (electric field strength, specific energy input, duration, temperature, pH, design of the highvoltage cell, etc.). On the other hand, the most complete profile possible must be developed regarding PEF-induced chemical/biochemical/microbiological changes in the food to allow a scientific comparison with traditional and/or authorised food treatment processes. In
particular, studies should focus on the extent of detrimental process-related changes caused by electrolysis of water or by generation of reactive oxygen or other species. Further issues that should be addressed include possible impacts on the allergenicity of foods and undesirable effects on proteins in terms of generation/stabilisation of proteolysis-resistant conformations.  
In the case of high pressure treated foodstuffs information on the specification of the origin and the composition of the product and on the technical details of the applied process, the apparatus and equipments as well as packaging materials is considered necessary to predict whether the potential of the process to introduce physical, chemical and/or biological changes in the food might have an impact on essential nutritional, toxicological and microbiological parameters. This includes a description of storage conditions of the food before and after application of the process. The food to which high pressure has been applied should be compared either to untreated counterparts or to counterparts which have been processed in a related traditional manner, e.g. thermal heating, with regard to the chemical composition and/or structure of inherent nutrients and toxicants of the food, taking into consideration the information available in the scientific literature. In particular, evidence should be provided, that an adequate destruction of health-relevant microorganisms has been achieved. In the future it would be desirable to develop product- and process-specific test parameters, in order to be able to carry out any future safety evaluation of high pressure treated foodstuffs according to recognised standard criteria.  
Until now, an approach to the study of plasmas in industrial plasma engineering is often to regard the plasma as a black box with inputs and outputs. Also in studies focusing on plasma application to foods the desired output of a plasma-related process is mainly achieved by adjusting inputs until the desired result is obtained. In this approach, no serious attempt is made to understand the plasma-physical, plasma-chemical, or plasma-biological processes occurring in the black box. In future, more interdisciplinary studies has to be conducted to overcome the isolation of researchers in many disciplines allowing a better understanding of the complex interactions during plasma processing and thus, resulting in design of beneficial and controlled plasma applications for food processing.

4 Specification of critical research needs and priorities with relevance for food safety and quality concerns and for improvements in food chain transparency

Food quality and safety depend on a great variety of influence factors, starting from the maintenance of several food hygiene concepts, regulations, laws and the implementation of an appropriate quality management system to the assurance of certain quality and safety requirements. The food value chain is a very complex construct, in which primary production and processing companies are often thousands of kilometres apart of each other so that the product streams are extended over the whole globe. Thereby different commodities are modified, merged and/or packaged and are passing several processing steps, which have great impact on the resulting product quality and safety. Besides the product stream, the information flow is of great interest: the communication along the chain, the compatibility between
different technologies as well as the management system and quality standard used play important roles. A challenging part in food quality management remains the information flow and communication along the food chain in order to transfer relevant data to subsequent steps of production.

This section summarizes deficiencies and research needs that have been identified regarding food quality aspects in the food chain. The main focus is on food processing as well as on the food value chain considering the availability and transfer of information. Legislative aspects as well as communication issues are discussed with regard to arising challenges for further development and research in this field. The most important research needs are seen in the following areas:

**Food chain complexity and emerging risks:** Besides the implementation of new technologies for transferring quality data and improving the coordination between the different stakeholders of the chain, the point of sale and point of use impact of the consumers on quality has to be investigated. Additionally, the transformation of available product quality and process related information into signals with regard to the consumer information needs remains a core task. Emerging risks bring particular challenges in terms of transparency and consumer / stakeholder confidence and require special attention.

**Analytical methods:** New processing technologies require new analytical methods. In general, fast and non-destructive methods with appropriate detection limits are required in order to guarantee a high degree of quality and thus, to build a basis for trust.

**Food processing technologies:** A re-evaluation of existing technologies from a food quality point of view seems essential, since there is no systematic approach and certain critical points are only revealed accidentally. Concerning emerging technologies, performance criteria and indicators have to be established. The development of manageable industrial scale technologies in order to translate the consumer perception into innovative products will be a key step for the further successful development and integration of emerging technologies.

### 4.1 Food chain complexity and emerging risks

Today, the food value chain is a very complex construct, in which primary production and processing companies are often thousands of kilometres apart from each other so that the product streams are extended over the whole globe. Thereby different commodities are modified, merged and/or packaged and are passing several processing steps, which have great impact on the resulting product quality and safety. Besides the product stream, the information flow is of great interest: the communication along the chain, the compatibility between different technologies as well as the management system and quality standard used play important roles. The primary production/raw material supply represents the crucial basis for all subsequent steps of the production of high quality foods. In the case of fresh fruits, vegetables and products like marmalade and fruit juices, the parameters like cultivar, maturity, microbial status, preservation treatment, genetic modifications, coating and pestizides have an important impact on the resulting quality and market acceptance. Analytical methods like the analysis of the stable
isotope ratios provide the opportunity to examine the origin of raw materials, spectrometric methods can be used to determine optimal time of harvest and mycotoxins can be quickly analysed by means of specific ELISA kits.

The distribution network and the retailer have big influence on the cold chain maintenance and, as a consequence, on the quality and safety of food to be kept at a low temperature. Thawing, for instance, generally leads to a rapid multiplication of inherent bacteria and to an increase of the enzymes’ activity. Freezing the food again leads to irreversible destruction of the plant tissue. As a result, the sensorial properties worsen since the food matrix becomes much softer. Therefore it is of great interest to permit an interruption of the cold chain. RFID sensors for instance could remedy this problem through a continual monitoring of the temperature.Further research is needed on the following topics:

Intentional and unintentional alterations in practices related to sourcing, formulation (including preservatives), processing, packaging etc. may lead to production of or selection for new, unforeseen risks. It is far from clear how the consumer views emergence and how he (she) attributes the responsibility. Where the scientific and technical community knows of a risk but has not had time to understand, translate and communicate this to other stakeholders, this can be perceived as a lack of transparency.

Post-shopping technology and food preparation at home as part of the chain: point of sale and point of use impact on food quality needs to be taken into account.

Foresight and scenario studies with experts and modeling approaches should be used to identify and prioritize potential hotspots of emergence in the food chain.

### 4.2 Transfer of information and communication along the chain

The multi-step nature of the food chain as well as the complex interactions between and within the different steps represents the most challenging issue when it comes to the transfer of food quality information along the chain. The coordination between the different actors as well as coordination of them seems to be the key point in order to realize a transparent food chain.

The consumer as part of the food chain seems to be the weakest point with regard to predictability and susceptibility of control actions to be taken in order to maintain the food quality that was generated along the production chain.

During the last years, these issues were countered in several ways. Technologies like RFID were developed, which are not only able to record quality relevant data like the temperature but also make them available for every part of the supply chain (Fig. 5).

However, it becomes difficult if different product streams merge: a sensor, which is commonly fixed on the packaging or the pallet, is not able to collect information anymore. Additionally, it makes traceability difficult. Research is needed on the following topics:

New technologies and appropriate coordination are necessary for the transfer of food quality information along the chain.

The complex structure of the food chain requires a higher level of integration of research from different disciplines.
Training concepts in food science and technology need a full chain approach and a comprehensive view. Mechanisms should be created to rapidly commission research in an attempt to anticipate potential risks and to catch new risks before their potential consequences are felt.

![Figure 5. Flow chart of a fruit and vegetable chain with RFID information flow.](image)

4.3 Food quality standards

Numerous food quality standards exist on national level. The development of uniform, international standards is needed because of the globalisation of product streams, increased consumer demands and not least because of a lack of trust, transparency and communication. Most of the standard owners have set their sights on the assurance of a good, consistent quality to strengthen the consumers’ trust. The question is: Is that enough?

Some standard owners, namely the owners of IFS (International food standards) and GlobalGap, try to enhance the communication and transparency within the food chain by developing specific online portals, through which the food chain members can obtain for instance information concerning the fulfilment of quality requirements of suppliers. Research is needed in the following areas:

**Up-to-date information through improved cooperation:** Advances in scientific knowledge and the development of new analytical methods are the basis for improvements in terms of food quality and safety and should be implemented into the requirements of quality and safety
standards without delay in order to guarantee optimal food quality at any time.

**International harmonisation of quality standards:** While maintaining branch-specific standards the harmonisation of regional and national standards towards international ones could lead to enhanced traceability and shed some light into the jungle of uncountable standards. Furthermore, stringent international accreditation processes may provide a higher degree of integrity. European and international standards and Codes of Practice need to be supported by industry, policymakers and society.

**Clear, unambiguous provisions in terms of labelling:** The transformation of available product quality and process related information into signals with regard to the consumer information needs remains a core task.

**Establishment and development of high quality and safety standards** are an essential prerequisite for consumer confidence in the food industry. Transparent, industry-led development and implementation of codes of good practice and standards for each sector are highly recommended, since such standards need to be continually revised and adapted to reflect continual improvements.

### 4.4 Communication with consumers/society

At the end of the food chain, the main focus lies on the link to the consumer. There, the product packaging or the declaration at the counter is commonly used to present information of ingredients, logos of test results and to highlight the products’ benefits. The producer also gets in touch with (potential) consumers using TV, radio, print and online advertising to convince them of the benefits and to stimulate them to buy their products. If these linkages should be used to increase the transparency and to enhance the consumers’ trust, the selection of relevant information is of great interest:

4. Which kind of information is needed to create trust?
5. How much information is sufficient?
6. When does an information overload occur?

These are the relevant questions in the context of searching possibilities to increase transparency in the food sector. The limiting factor is not the availability of information, since the quality as well as the quantity of analytical methods and information transfer technologies rapidly increased during the last years.

One possible solution concerning question 1 could be to clarify and to communicate full and transparent information on both risks and benefits for traditional and novel products. This needs good cooperation between researchers, policymakers, industry and consumers. A successful example of assessing the risks and benefits and communicating them to consumers is cheese made from unpasteurised milk: clear procedures for production and labelling allow consumers to make their own choice. The problem is, that in other areas the real risks are not yet always so well quantified and unsubstantiated opinion can counter development.

Furthermore there is often a lack of trust because of the limited knowledge of the consumers regarding the food production. Thus, imparting relevant knowledge of the science and
technology would be a solution to increase it. All research, education, innovation and business communities should be transparent, open and clear about all developments if the sceptical and negative feelings of some parts of society to novel products and processes are to be overcome, e.g. by using new ways of communication like twitter, youtube, and facebook. Scientists and technologists need to become more aware of societal perspectives and both understand and address these throughout their work; proper, balanced communication on the risks and benefits both of commercialising processes and products or not is essential. Communication needs to be with members of the public with all levels of education rather than just an elite and attention is also needed for communication on the implications of food industry developments for the various sectors and stakeholders. Overall, better communication can support the improvement of the public image of the food industry by both improving public understanding of the science and technology and increasing awareness among scientists, technologists and industrialists of what the public is really concerned about. All those involved in food industry commercialisation, R&D and education must include open and accurate communication with the public as part of their roles and take account of public perception in planning and carrying out their work programmes. Coordinated action on specific topics is required.

It is also required to develop knowledge representation and decision-making tools based on stakeholders needs of the whole processing chain and on the development of knowledge reasoning models and tools that will go until the resolution of conflicts. Research is needed on the following topics:

Who needs/wants which information and what for? Relevant information for transfer along the chain has to be selected in order to avoid confusion (due to information overflow) or a lack of transparency due to missing information.

Further knowledge needs to be generated as to how the consumer views emerging risks and more importantly how the consumer can accept some degree of new risk without losing confidence in the chain.

### 4.5 Analytical methods

The improvement of analytical methods contributes to an improved availability of information and may increase the level of transparency. Fast and non-destructive methods for quality analysis need to be further developed as a basis for the immediate quality control and management. Research is needed on the following topics:

New analytical and other scientific capacities can identify risks which had previously been unknown. The consequence in the food chain of emergence does vary according to the specifics but there are certain scenarios which would be common for any of the sources of emergence. New product formulations and new processing technologies require a revision of traditional quality specifications. Underlying analytical principles as well as detection limits need to be adapted to current needs.

The applicability of quality definitions to new products requires a re-evaluation since most
product characteristics have been developed based on traditional product specifications and may not be applicable for products processed by emerging technologies. **Process control and process analytical tools as well as process sensors are required** in order to provide relevant data on the process and product to allow a high level of transparency regarding the availability of information in the context of life history of a product or online evaluation of process performance.

Systematic and reliable data recording is now common across many areas in Europe, but it is increasingly important that standards are developed and applied internationally to avoid distortions in national and regional markets as well as the global food industry. Not only should standards always be developed on a basis of science, but they should have the support of industry, policymakers and society. Inevitably, the best operators provide the **push for the highest standards**. The effect is to pull the aspects of food quality and safety to higher levels. It is essential not only to identify such contributors but also to engage these players in the process of developing and reinforcing such standards. There must be continued development of European and international standards and Codes of Practice both for improving food quality and safety and to reinforce public trust. As well as addressing safety and quality, standards should also play a positive role in promoting sustainability and innovation.

### 4.6 Food Processing Technologies

*Traditional Technologies*

The area of food quality and manufacturing plays a central role in the food chain and for the different levels of transparency occurring within. The step of manufacturing is by far too narrow to define the complex processes involved in food production. Manufacturing implies that processes of change in the food product stop when the food product is made and in terms of processed food, the term manufacturing is very much focussed on the conversion of the raw material without paying enough attention on the raw material itself. Regarding the food product and the whole chain of food production it seems necessary to look beyond the current structure of the different steps involved. This needs to include the raw material production as well as the processing in general and the storage until the time of consumption. Terms such as packaging play also a crucial role in communication, logistic, freshness and safety monitoring and need to be taken into account as well. Main areas for further investigation are:

A greater integration in research is required between raw material production, processing, food quality, safety, nutrition and sustainability. Research programs need to be more collaborative between disciplines in large research topics. Apart from the food industry itself, training concepts in food science and engineering are required in such a way, that it enables to initiate research across the borders of scientific disciplines. Concepts considering a full chain approach need to be implemented in future research programs in order to allow a comprehensive view on the food chain and to focus on transparency as a key point within a complex network of food production.

Traditional food processing and traditional food processes have been widely used in Europe in
the past and do still include local particularities. These processes have generated healthy, functional foods which could also be exploited in modern society. Reinventing these processes requires the understanding of the traditional processes mechanisms and subsequently their transfer and upgrading to modern industrial processes. A re-evaluation of existing technologies from a food safety and food quality point of view is required. Novel processes have to undergo an intensive evaluation regarding toxicological risks etc. There is no systematic approach for the existing traditional foods and certain critical points e.g. the formation of acrylamide are revealed accidently.

For this purpose, an effective food process optimization by integrated modeling of food chains and unit operations are required in order to generate and validate data for food quality changes during food production and storage. Aspects such as point-of-sale retailing and processing and point-of-use processing need to be taken into account in terms of occurring modifications of food quality and in terms of the availability of knowledge in order to guarantee a transparent way of food handling. Post-shopping technology and food preparation at home needs to be included in the food processing chain as an part of growing importance.

Emerging Technologies

Research needs regarding emerging technologies may involve:

Concerning emerging technologies, the establishment of a synchronized process assessment including the development of process performance criteria or indicators can be identified as a main research need. A re-evaluation of product-specifications and analytical means may be required in order to adapt them to the requirements of novel products. The lack of information on inactivation kinetics and reaction mechanisms of nutrients, toxins, allergens, microbes and viruses, shelf-life studies, epidemiological studies, effects on digestibility, on allergens, phytochemicals and melanoidins clearly indicate further research needs regarding emerging food processing technologies.

The number of substantiated studies is limited in all areas, and a consistent evaluation of the technologies is still hindered due to the lack of standardisation of process parameters. Development of criteria to assess the process or the treated foods requires, among other things, the characterization of suitable indicator substances and measuring parameters in the same way that they have been established for traditional thermal processing already.

The development of manageable industrial scale technologies in order to translate the consumer perception into innovative products will be a key step for the further successful development and integration of emerging technologies. Scientists and technologists but also public policy makers with both converging as well as diverging views need to become more aware of societal perspectives and both understand and address these throughout their work; proper, balanced communication on the risks and benefits. This would enable rational decisions to be made on the basis of scientific evidence, taking account also of economic, environmental and health issues and both short and long-term impacts of alternatives, and allow all information to be properly communicated to consumers.
4.7. Summary

The area of food quality and manufacturing plays a central role in the food chain and for the different levels of transparency occurring within. However, when considering the whole food value chain, a greater integration is required between raw material production, processing, food quality, safety, nutrition and sustainability. Research programs need to be more collaborative between disciplines in large research topics.

New analytical and other scientific capacities can identify risks which had previously been unknown. The consequence in the food chain of emergence does vary according to the specifics but there are certain scenarios which would be common for any of the sources of emergence. When food products pass through modern, brand-driven chains the levels of stringency are more harmonized across national borders. This is essentially due to the fact that major brand holders will stipulate key specifications for food safety, often anticipating and/or exceeding legally imposed levels of protection according to current scientific knowledge.

Concerning emerging technologies, the establishment of a synchronized process assessment including the development of process performance criteria or indicators can be identified as a main research need. A re-evaluation of product-specifications and analytical means may be required in order to adapt them to the requirements of novel products.

The consumer as part of the food chain seems to be the weakest point with regard to predictability and susceptibility of control actions to be taken in order to maintain the food quality that was generated along the production chain. Better communication will improve the public image of the food industry and needs to take into account the different levels of education and different levels of required information.

5 Conclusions

Deficiencies and research needs regarding food quality aspects of transparency have been identified in this chapter as a result of the analysis of the availability and transfer of food quality related information along the production chain.

The role of food quality was highlighted with regard to the final end-product quality but also with regard to previous steps in food production considering quality requirements for raw materials or semi-finished goods. The communication of quality related information is the key prerequisite for achieving maximum end-product qualities within a multi-step production process. Hence, approaches concerning the enhancement of the information flow and quality controls along the food chain are of utmost importance.

The interests of consumers are mainly focused on the food quality characteristics of the final product for assuring constant product specific properties. However, the food sector needs to serve interests in products and processes including information items that can not be directly identified based on final product evaluation. The analysis of food quality along the production chain can be performed based on a large number of specifications, management and certification schemes that are available for the different food product categories. However, in order to increase the efficiency of quality management, a further reduction and harmonisation
seems still appropriate.

Consumer trust in food products and especially in branded foods contributes to a large extent to a certain quality perception which – in some cases - does not require any further communication. However, the translation of consumer perceptions into manageable industrial scale technologies is a major challenge for the food industry and offers a large potential to modern food-processing.

Efficient qualitative traceability systems can assure the information flow along the production chain, and finally assist in assuring consumers health and safety as well as the maintenance of high quality levels by enabling rapid recall and withdrawal of hazardous products. However, the challenging part in food quality management remains the information flow and communication along the food chain in order to transfer relevant data to subsequent steps of production.

Besides the implementation of new technologies for food production and for transferring quality data to the different stakeholders of the chain, the transformation of available product quality and process related information into signals with regard to the consumer information needs remains a core task.

A greater integration will be required between raw material production, processing, food quality, safety, nutrition and sustainability. Future research programs need to be more collaborative between disciplines in large research topics in order to successfully deal with the above discussed complexity in the food chain.
C FOOD CHAIN INTEGRITY

ABSTRACT
The minimisation of negative impacts and the enhancing of positive impacts of social, ethical and environmental aspects of food chains are increasingly becoming important values around which food choices are made. Communication of these values relies to a great extent on processes of transparency that rely on tracking and tracing in combination with the use of clear, simple and up to date information communicated in an effective way. As a background for suggesting innovations in order to improve transparency of environmental, social and ethical impacts related to food in future an overview the information use in food chains with relevance for environmental, social and ethical concerns has been made. Representative initiatives/certification schemes addressing these issues have been systematically analysed in detail on how these aspects have been dealt with in the existing food chain. It was concluded that although important efforts are being made by private and public bodies to improve transparency of food chains, some basic requirements are still not met and need further research. These are related to the identification of the relevant traceability reference units, how indicators can be improved to better reflect the impact envisaged to be reflected, and how the data handling infra-structure can be improved – also in relation to the costs.

1 Introduction
Recent decades have witnessed growing consumer awareness and, in turn, demand for information on the environmental, social and ethical aspects of food as well as the safety and quality attributes. The demands upon food integrity, which cover the credence attributes of food products, as opposed to safety and quality features, are also an emerging feature of the food and sustainability policy agenda. Public policy is increasingly adopting and embracing reporting mechanisms and methodologies to assess environmental impacts of the whole food chain process and the product’s whole life cycle. Also, policy makers are looking to market led initiatives, in the form of certification schemes which set and monitor standards for food with accompanying logos and labels. These certification schemes are setting different types of integrity standards, originating from the corporate sector and civil society organisations, to promote more sustainable food in the wider interests of society as a whole. It is widely acknowledged that transparency within the food sector is of crucial importance to the sustainable development of the sector. Due to the very complex structure of food systems and food the issue of transparency is also very challenging and dynamic in nature, especially since priorities in transparency issues may change over time.

Transparency can be considered as a way to create trust; by knowing that all relevant information is available for scrutinizing, trust will be created on the grounds that no one actor will misbehave. To be able to improve transparency and to develop tools for transparency which are able to adapt to further and possible future changes in societal and consumer focus it is necessary to understand the complexity of the food system as well as the background to the actions already taken. This chapter aims to provide a state of the art on existing information use
in food chains with relevance for environmental, social and ethical concerns together with appropriate background information on the environmental impact of food production and details of the initiatives that have been undertaken. In addition, the next sections elaborate a framework for considering aspects of environmental, ethical and social concerns, before exploring how these issues have been managed under some key current food certification and reporting schemes and the degree of transparency in these schemes. In particular, the chapter offers an analysis of the transparency implications of the schemes for transmitting information to interested observers and as means for providing more comparable and reliable measurement of the relevant impacts.

2 Environmental, Social and ethical concerns around food

Environmental, ethical and social concerns are reflected in a number of national and EU policy measures on the one hand; and in actions from civil society based organisations and companies on the other hand. Major aspects on the agenda at present are emissions of greenhouse gases contributing to global warming, depletion of natural resources, loss of biodiversity and wildlife through intensive agriculture and fisheries, exploitation of poor farmers and farm workers, the unfair distribution of profits along the food chain, and animal welfare issues.

2.1 Environmental concerns about food

Food and feed production and consumption contribute substantially to the environmental footprints of society. According to the Environmental Impacts of Products (EIPRO) Study published by the Joint Research Centre of the European Commission in 2006, food and drink, together with transport and housing, are consistently the most important areas responsible for the greatest environmental impacts in the EU – across both different studies and the different impact categories (Tukker et al., 2006). Together they account for 70 to 80 per cent of the whole life cycle impact of products. According to Rockström et al. (2009) three areas of environmental degradation closely associated to food production have already gone beyond what can be considered safe limits, and these are; loss of biodiversity (loss of species), input of reactive nitrogen to the global nitrogen flows, and emissions of greenhouse gases. The food system is responsible for 20 to 30% of all emissions of greenhouse gases (GHG), and is the dominating user of chemically synthesised nitrogen-fertilizer, which causes disruptions in ecosystems by eutrophication of waters and soils. Agriculture is the absolutely dominating land use and the dominating driver for deforestation and transforming permanent grasslands into arable land. So the loss of biodiversity is obviously strongly connected to food production. For resource use, food production is the largest user of fresh water and a significant user of energy. Finally, food production is the dominating user of phosphorous, which is a limited and definitely essential element for all living organisms.

Food production systems as a group are very heterogeneous, the range of products is huge and production systems vary within product groups as well. However, there are some common traits. In agriculture the environmental impact is often dominated by emissions from biological processes in soil, from manure and animals, and it also has a range of impacts such as eutrophication, pesticide use and biodiversity loss. There are also large differences between production regions and also

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1 The content in this chapter represent the research findings and conclusions made based on an inventory carried out within the Transparent Food Project in the early summer of 2011
between years. This makes environmental impacts from agriculture difficult to measure and control. For post farm links in the chain impacts are mainly connected to energy and water use, effluents, waste of raw materials and methods for waste management or upgrading. For some products packaging and transport can contribute significantly to the products total environmental impact. A very general statement is that animal products have the biggest environmental impact, vegetables lower impacts, and seafoods are extremely diverse in level of impacts. Moreover, primary production is the most important step for at least animal products but is also important for vegetable products. Later steps, processing, packaging and transports, are often of less importance, but there are many exceptions.

The focus in environmental awareness and research in the food sector has been moving from mapping and understanding the environmental impacts of products, towards: improving the production both in short and long term, and including a broader range of aspects such as economy, food safety and quality. Another observation is that food chain actors as industry, retail and public authorities interact in research and development more actively which is a prerequisite for research to focus on short term achievements and at the same time involve industry in approaching the long term grand challenges. For an overview, within Carbon Footprinting, see Bolwig and Gibbon (2009), and Ernst &Young and Quantis for the European Commission DG Environment (2010).

2.2 Social and ethical concerns about food

The social dimensions of food are identified in the first instance from the social context and societal impacts of food production, food chain practices and food consumption. With regard to transparency, food has a social dimension in that the food and its production and practices along the chain affect or impact upon:

a) the well being and/or cohesion of societies or,
b) have impacts which raise societal based concerns.

Hence, the social dimension includes a variety of issues including: the quality and security of the food supply, the efficiency and accessibility of the food distribution systems, the distribution of income within agriculture and at other stages of the food chain, the working conditions along the food chain, the community and social cohesion terms of food access and of the economic vitality in rural areas. The quality of the food supply includes the health impacts of the food available to consumers and other societal based concerns such as the welfare of animals or the provenance of food. Food provenance may also be viewed through a cultural and social lens as with Halal and Kosher food.

Any human intervention has the potential to give rise to ethical concerns; to impact upon others which may include humans but also other life forms and their interaction (such as in ecosystems). Hence, food ethics can cover a wide range of issues. Ethics involve subjective as well as objective judgements as they can reflect different combinations of moral values when applied to practical situations.

The focus here is upon the types of ethical concerns that have arisen over the food production and supply chain systems. A recent comparative European study of ethical dimensions which sought to
identify the extent and forms in which they arose in different commodity to food supply chains drew up a potential range of ethical concerns (Coff et al 2008). Nine broad social and ethical concerns that are relevant to food production which are relatively substantive in nature around the food product and the food chain processes and practices are identified in Table 1. This list is not exhaustive. Indeed the list remains open to include any new or unforeseen concerns that might arise from the supply chains studied. Social impacts and concerns and food ethics are dynamic in their nature and new concerns may arise.

| **Table 1**                                                                 |
| **Categorisation of areas of social and ethical concerns about food which incur some form of food chain transparency** (adapted from Coff, Korthals & Barling 2008) |
| **Animal welfare** (welfare of livestock and wild animal catch from rearing/capture up to and including slaughter) – mainly ethical but as such raises societal concerns |
| **Human health** (impact of products upon human health; dietary health impacts; link to food safety and hygiene; animal disease; working conditions) |
| **Food security, availability and access** (to adequate safe, nutritious and culturally appropriate foods; UN “right” to food) |
| **Methods of production and processing** (e.g. Organic, Integrated Pest Management/Farm Management techniques, Halal, GM, Kosher, free range or cage reared – animal welfare etc) |
| **Environmental and ecosystem impacts** (sustainable agriculture codes, IPM/IFM; fisheries stewardship; natural resource protection; carbon footprinting/labelling; water stewardship etc) |
| **Terms of trade** (fair price for producers and suppliers; fair trade; fair contract terms etc.) |
| **Working conditions** (e.g. labour standards; worker safety and working conditions; hours of work and wage levels etc) |
| **Quality** (intrinsic & physical characteristics of products such as taste, composition, etc.) |
| **Origin and place** (Geographical Indicators; Country/Region of origin etc) |
| **Social capital and community cohesion** (Rural communities’ well being and economic vitality; utilisation and building of social capital of farmers and growers and of communities) |

Certainly the list would have been both different and shorter had it been drawn up twenty years or thirty years previously. These are concerns that relate directly to the consequences of production practices or to the consequences or impacts of food consumption, for instance human health and food quality. They will vary according to the specific food product.

Inevitably, in any such attempt at typology there are some possible overlaps and clear interrelationships between these concerns as table 1 indicates. For example, ‘working conditions’ can relate to ‘terms of trade’. Equally, ‘origin and place’ may be linked to concerns around ‘working conditions’, such as with food from developing countries. Similarly, taste can relate to methods of production, as can animal welfare. Methods of production can relate to ‘origin and place’ as with the Protected Designation of Origin (PDO). Furthermore, each concern may embody more than ethics. For instance, ‘origin and place’ may not necessarily be an ethical parameter, but people make a lot of associations with origin and place that involve ethical judgements.

Finally, given the subjective nature of prioritising such social and ethical impacts, their appearance in food supply chains in terms of standards and certification schemes reflect the complex origins of
social concern and the equally complex dynamics of political advocacy. These complex processes lead to the translation of social and ethical concerns into management systems for auditable and verifiable standards, agreed to and implemented by actors in the food chain. Usually, the enactment of such certification schemes involves a degree of involvement and cooperation from civil society organisations. On occasion, the prime mover and organiser may be civil society organisations, as with Fair Trade. Where civil society organisations are prime movers they need the cooperation of the food chain actors to implement the scheme (Barling 2009).

3 Transparency and Integrity in the food chain

Food Transparency is concerned with the forms and flows of information and access to the information about the food chain practices relating to the food product as well as the final composition, characteristics and history of the product. Transparency in the food chain aims towards integrity, that is, providing everybody with both a stake and an interest in the food production and food consumption with relevant information for making informed decisions on an objective basis. In this context monitoring, measuring and addressing ethical, social and environmental impacts are important for building trust.

The minimisation of negative impacts and the enhancing of positive impacts of social, ethical and environmental aspects of food chains are increasingly becoming important values around which food choices are made. Communication of these values relies to a great extent on processes of transparency that rely on tracking and tracing in combination with the use of clear, simple and up to date information communicated in an effective way.

The wide range of environmental, social and ethical concerns may occur around various dimensions of the food production and supply. In this chapter we focus on:

- Environmental and ecosystem impacts
- terms of trade
- working conditions
- animal welfare
- social capital and community cohesion
- Production and processing methods that are explicitly cultural based on religious views and occur irrespective of geographical situation (i.e. Halal and Kosher)

Social, ethical and environmental impact “history” cannot be measured in a product. Thus such information must be secured all along the supply chain to obtain transparency. This is a major difference from health claims based on composition, for example, and, to some extent, food safety claims that can be confirmed by direct measurements on the food product itself. Even though the authenticity of a claim regarding the origin of a food product can be checked by the isotope ratio, for example, this cannot be used as a measure of the environmental impact. Consequently, transparency for social, ethical and environmental impact relies on accurate and transparent information recording and flow along the food chain, business to business as well as business to consumer. On a product basis the transparency of environmental, ethical social aspects is generally
addressed in two ways. First, by *business to consumer communication (B2C)*, often by labelling food that is supposed to have certain integrity characteristics, like carbon footprint or fair trade. Second, by *business to business communication (B2B)* that often ensures that certain standards have been used in producing the goods used in the further processing or that e.g. retail chains can be assured about the production standards. 

*In the following elaboration, as presented in the next sections, a large number of instruments relevant for communication of environmental, social and ethical concerns both from industrial and/or agricultural activities and processes as well as from products and services were screened, with a focus upon European actions and schemes.*

4 Assessing the state of the art of information use

Transparency of social, ethical and environmental impact relies on a proper and transparent communication along the food chain, business-to-business as well as business to consumer as stated above. This is often systematised in the form of so-called (product) certification schemes and standards, which aim at providing confidence in certain product lines and food chains based on a set of guidelines on production and processing and/or guidelines for quantification, documentation, control and labelling. These are referred to as “schemes” in this report. A number of schemes for food products presently exist that seek to address environmental, social and ethical concerns and to signal this in relation to the trading partners (B2B) or consumers (B2C).

Certification schemes are suggested to offer a “visual transparency”, making it possible to “see along the chain” (Muttersburgh and Lyon 2010). This is because the standards contained within processes of certification reveal substantial amounts of information relating to the practices and processes occurring along the food supply chain. Thus, certification schemes are used to signal information to businesses and consumers about both product and processes along the food supply chain. Therefore, certification schemes were identified as critical in evaluations of information use in transparency.

According to the perception of transparency adopted in this chapter the transparency of a scheme relates to

- The information provided. It must be relevant and coherent with the aim of the scheme. The selection of information and the consequences of the selection must be understood by the intended receiver. The quality of information must allow a fair comparison between products and have the capability to promote trust.

- Willingness to share the collected information and forms of securing trustworthiness and credibility

Based on this perception three major areas of the features of the schemes were focused on:

- Clarification of the *background of the schemes*: the idea behind them, the drivers for their establishment and the ownerships of the schemes.
• **Attributes supporting transparency**: the level of implementation, target group (e.g. business to consumer or business to business) and how the message is communicated as well as the overall content of the scheme.

• **Indicators for transparency**: by assessing the verification, the formal accessibility (openness) of information, the consumer accessibility (ease of understanding), and whether the scheme requires that information is available for specific consignments / product lots (a prerequisite for food chain communication on product item level).

Thus, the schemes described in section 5.1 and 5.2 were described according to the following features:

• Origin
• Primary aim of the scheme as identified by the scheme owner
• Geographical coverage
• Reach (B2B or B2C)
• Drivers (regulation, product differentiation, image, safe-guarding image, citizen concern)
• Ownership
• Level of implementation (individual products, range of products, non product specific operations)
• Principle for communication
• Verification (third party or internal)
• Formal accessibility of information
• Consumer accessibility and whether expert knowledge were required or not to understand the information.
• Actual indicators used and whether these were minimum requirements for different stages in the food chain or they described the history of the individual food product distinguishable from other products

The schemes were assessed, using the open information provided by the owner, against a list of criteria reflecting a range of ethical, social and environmental dimensions of food as well as availability and comprehensiveness of information in relation to the ethical, social and environmental aspects of the schemes and in turn, of food – in relation to both product and process. **It is noteworthy that most standards and methodologies are generally very recently developed.**

### 4.1 Selected schemes serving environmental transparency

*For the environmental standards there are basically three major foci for the schemes: those that relate to good primary production practices, those that relate to organic production, and those that relate to climate labelling and/or carbon footprinting. Environmental management systems contribute less to transparency since they do not specify any level of environmental performance.*

*Regarding “good agricultural practice types of schemes”, the schemes certify that the production to a large extent follows legal rules and regulations and other criteria for good agricultural practices – the benefit from the transparency point of view being that farms and businesses are routinely inspected*
to certify compliance with the requirements. In addition, a learning element is included aiming at constantly improving practices. Many schemes relating to good farming activities are based on/partly based on the GLOBAL G.A.P standard. In a similar way the Marine Stewardship Council (MSC) Fishery Standard states criteria for sustainable fishing.

Regarding organic agriculture the production has to follow certain practices and criteria where some (otherwise legal) production techniques are not allowed. A particular feature is that no substance can be used as input unless explicitly approved – i.e. only those appearing on a positive list. Provisions for organic production, labelling and control are laid down in the EU regulations EC 834/2007 and EC 889/2008.

The carbon footprinting approach is an attempt for individual businesses to quantify and communicate the actual greenhouse gas emissions caused by the production, in contrast to the schemes that relate to good agricultural practices and organic production, based on compliance with specific criteria. However, one example of a criteria based climate labelling scheme has been found (Svenskt Sigill Climate Certification Scheme).

A number of schemes were selected for a detailed examination based on a combination of criteria to cover different approaches and levels of legal status. The schemes focused were:

- Bud label (BioSuisse Knospe) ([www.bio-suisse.ch](http://www.bio-suisse.ch))
- Coop Änglamark ([www.coop.se](http://www.coop.se))
- Eco-Management and Audit Scheme (EMAS) ([http://ec.europa.eu/environment/emas](http://ec.europa.eu/environment/emas))
- ISO 14000 series ([www.iso.org](http://www.iso.org))
- Svenskt Sigill climate certification ([www.svensktsigill.se](http://www.svensktsigill.se))
- Environmental Product Declaration (EPD) according to the International EPD System ([www.climatedec.com](http://www.climatedec.com))
- Environmental reports SE ([www.naturvardsverket.se](http://www.naturvardsverket.se))
- Global G.A.P. (environmental issues) ([www.globalgap.org](http://www.globalgap.org))
- The Swedish Seal (Svenskt Sigill) ([www.svensktsigill.se](http://www.svensktsigill.se))
- Approved by Climatop ([www.climatop.ch](http://www.climatop.ch))
- L’indice carbone (Casino) ([www.produits-casino.fr](http://www.produits-casino.fr))
- Max climate declaration ([www.max.se](http://www.max.se))
- GWP information from E Leclerc ([www.e-leclerc.com](http://www.e-leclerc.com))
Coverage
Generally, the process-oriented schemes have been in place longer and are thus more widespread than the product-oriented schemes\(^5\). Global G.A.P is the world’s leading pre-farm gate scheme with nearly 100,000 certified producers in more than 100 countries. The ISO 14001 is implemented in 155 countries and the growth rate in 2008 was about 35,000 new certificates a year (all type of organisations)\(^6\). About 200 food and drink companies, 4,500 organisations in total have an EMAS registration. The MSC standard covers about 200 fisheries worldwide. The National Schemes Bio Suisse has 5,700 farmers registered and Svenskt Sigill 4,000 farmers.

Although a great deal of attention has been focused on climate labelling, few products are actually labelled (2010). The most successful initiative so far is the Carbon Reduction Label (based on PAS2050), which passed a value of £2 billion 2010\(^7\). E Leclerc’s carbon label comprises 20,000 food items while Casino has about 100 products labelled. The International EPD register includes only 12 food products of totally 100 (approx) and Climatop covers 3 certificates valid for 8 food products.

Reach
The majority of the schemes are aimed for business to consumer communication. ISO14001, EMAS, Global G.A.P. cover the business-to-business level of the chain. The Environmental reporting is the only example having legislative reach. Schemes with an pronounced international reach include: ISO 14000 series of standards, Global G.A.P., the PAS 2050 standard, the MSC standard, the International EPD\(^8\) system as well as the WBCSD/WRI GHG Product protocol and the label Approved by Climatop. On the European level there are the Euro-leaf (regulations on organic production) and the EMAS regulation. Then there are a number of national ecolabelling and GHG labelling initiatives as well.

Origin and Drivers
The oldest environmental schemes were related to organic farming and primary production e.g. Bud Label which came into effect back in 1981. The initiatives came originally from the farming organizations. The development of national schemes was followed by the EU regulation on organic farming in the early 1990s, aimed at harmonising the national schemes. Both European and national organic schemes are intended for communication to consumers. The driver is citizen concern and the willingness of the enterprises to answer this concern (product differentiation). The voluntary schemes of ISO 14000 series and EMAS were introduced in the mid 1990s, and they both represent standardised environmental management procedures for all types of organisations. ISO14001 and EMAS operate on an organisational level. EMAS is an extension of ISO14001 with respect to the requirements on publically available environmental information. EMAS has an open access to the background information that is not the case for the ISO14000 standards, where only the private certification body has access to the background information. The Swedish Environmental Product Declaration (EPD) system was the first of its kind and was introduced in the late 1990s. It is now a part of the International EPD system. The final reports on declared products are published in the format of an LCA summary on the website showing results and selected background data.

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\(^5\) The numbers provided were retrieved from the home pages provided above being accessed October 2010.


\(^7\) UK annual retail sales is between £300 and £400 billion
The next “step in evolution” was the development of standardised good practices for pre-farm gate production of food. The retail sector in the UK initiated in the late 1990s the EUREP G.A.P., which now is a part of Global G.A.P., the most wide spread pre-farm gate certification scheme. Another assessed scheme, belonging to this pre-farm gate group is Svenskt Sigill, which was launched 2003 by the Federation of Swedish Farmers. Most schemes for good practices for pre-farm gate production of food are national, although several of them are partly coordinated with Global G.A.P. Global G.A.P. operates only on a business-to-business level while others also operate on a business to consumer level (Svenskt Sigill). Coop Ånglamark is a private label brand initiated by a major Scandinavian retail organisation and stands for “Organic food and environmentally labelled products”. It does not have its own certification scheme but certification from approved schemes is required. As a response to the climate debate Svenskt Sigill also introduced a climate certification system in 2010 as an add-on to the original standard.

A successful approach for developing schemes is “round the table discussions” where there is collaborative consultation between stakeholders in a specific sector. The international Marine Stewardship Council’s (MSC) environmental standard, which was established 2002, evolved from such a process. Further examples include Round Table on Responsible Soy (RTRS) and the Roundtable for Sustainable Palm Oil (RSPO, 2012). The MSC standard is used for business to consumer communication. It is owned by a non-profit consortium and the background information is open. The compliance with the standard is shown by a label.

The climate debate has accelerated the development of schemes aiming at reducing the GHG emissions. PAS 2050, the UK “standard” for calculating greenhouse gas emissions for a product, is the basis for the Carbon Reduction Label awarded by the Carbon Trust. Climate declarations initiated by retail/restaurants (e.g. E Leclerc, Casino and Max) were all launched in 2008. In all cases the level of greenhouse gases is communicated as a number or/and on a sliding scale (Casino). The background information of the number are however not publically available. The “best in class” label, approved by Climatop was also introduced 2008. In this case, a summary of an Life Cycle Assessment (LCA) is provided on the web. In addition of being “best in class” regarding GHG, the environmental performance of other environmental aspects must be at least equal to all other analysed offers. In addition, a list of exclusion criteria must be complied with. Two standards, both with international reach, from ISO (not assessed) and WBCSD/WRI, for the life cycle based calculation and communication of GHG, are still under development. While the ISO development is fairly closed but for member organisations, the latter organisations have published draft versions of the rather “hands-on” type of standard, comments from the road-testing as well as on-line feedback forms to make additional revisions.

The only non-voluntary system assessed is “Environmental reports according to the Environmental Code in Sweden”. This reporting system is required for demonstrating compliance with legal permits and is thus a mandatory “business to authority” communication. The reports also serve as basis for
environment reporting to international organisations and registers. The Swedish environmental reports are public according to the Swedish principle of free access to public records.8

4.2 Selected schemes serving social and ethical transparency

The certification schemes studied covered the areas stated in section three and are characterised by openly aiming to promote social and ethical values; for example: the Fairtrade schemes primarily aim to ensure fair prices are awarded to producers under the “terms of trade”, the Ethical Trading Initiative (ETI) concentrates its aims on improving pay and working conditions for workers, and the Recommended by Animal Welfare Association scheme is intended to ensure that particular animal welfare aspects are addressed beyond minimal legal requirements in this area. In addition, we assessed the standards of a prominent certification scheme, GlobalGap. This enabled a comparison of GlobalGap (a scheme that is driven by quality and safety concerns) with socially and ethical driven schemes.

The schemes we focus on in this section are:

- Ethical Trading Initiative (ETI) (www.ethicaltrade.org)
- Fairtrade certification schemes (www.fairtrade.net)
- Fairtrade Labelling Organisation International (FLO) (www.flo-cert.net)
- Traidcraft (www.traidcraft.co.uk)
- Rainforest Alliance (www.rainforest-alliance.org)
- GlobalGap (www.globalgap.org)
- EU Organic Agriculture (livestock) (http://ec.europa.eu/agriculture/organic/splash_en)
- Recommended by Animal Welfare Association (Denmark)
- RSCPA- Freedom Foods (http://www.rspca.org.uk/freedomfood)
- KIR Kosher Food Certification (www.koshercertification.org.uk/Abouttheki.html)
- HMC (Halal Monitoring Committee) Certification Scheme (www.halalmc.net/halal_certification/overview.html).

Regarding animal welfare 27 voluntary (private) schemes were identified in Europe recently (Schmid & Kilchsperger, 2010) with different degree of coverage among livestock species and processes. Here we studied the organic EU regulations, EC 834/2007 and EC 889/2008 (that have a very wide coverage) and a scheme that was implemented on top of that (Recommended by Animal Welfare Association). In addition, we focused on RSCPA-Freedom Foods – a scheme that covers a wide range of livestock species (but does not focus on organic).

Consequently, the investigations of the transparency of these schemes were conducted, and the strengths and weaknesses assessed against the criteria laid out. The investigation relied upon access

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8 The implementation of EU Community environmental legislation is to be ensured in the first place by the Member States, thus the Environmental Code and reporting systems varies from country to country)
to web based materials and information that any interested member of the public could access at the time. The key results of the subsequent analysis of this access and the implications for transparency are presented in the next sections.

5 Discussion

5.1 Thematic observations

Environmental impact

In our analysis we found that most important environmental issues concerning the food chain are covered in the schemes in different ways. None of the schemes includes all relevant aspects, for example, schemes aimed for quantitative data are greatly overrepresented by schemes focused on GHG. Thus:

- Today, environmental performance is commonly assessed/accomplished by different process-oriented approaches. The information available on procedures and processes is scattered between the different schemes.

- The development of major standards as Global G.A.P. and the harmonization of national standards with major standards as EU organic are important as they lead to conformity in the information flow that facilitates transparency.

- Environmental information from many systems is not openly accessible, but kept by either producing companies or by certification organizations. Criteria may be open, but the result from an audit or certification process is seldom open. A particular complication with respect to transparency is when standards e.g. Global G.A.P uses different levels of compliance criteria (e.g. “Major Musts” “Minor Musts” and Recommendations).

- Environmental impact data, when quantified, are generally based on a very large number of data that are merged to describe a given environmental category (e.g. Resource utilization, GHG, acidification etc) according to given rules (LCA ISO14040, 14044). Background data are provided in some cases but only to a certain level of detail.

- System boundaries have a great impact on the analysis. Thus a reported value e.g. the amount of GHG associated with a product, needs to be supported by a large amount of data and meta-data to be fully transparent. The development of common and harmonised calculation rules for a specific product group, so called Product Category Rules (PCR), would probably facilitate transparency.

- Environmental data are often calculated as an average, from a number of farms, a country or region and sometimes also for an average of several years. Hence the information as used in product-oriented approaches today is generally aggregated and can rarely be used to distinguish between similar products.
In conclusion, the schemes give a reasonably good coverage looking at what issues are accounted for all together. However, there are some critical environmental aspects poorly represented in the schemes assessed. The emissions of toxic substances, e.g. pesticides but also heavy metals, are not covered in many schemes. A possible reason is that toxicity is a methodologically complex and difficult impact category. A second lacking issue is water use.

There are numerous of ongoing activities that may greatly influence the future transparency of environmental information along the food chain.

An important factor for achieving transparency is **consensus on how to communicate environmental information**. As consensus is reached, indicators can be defined and a standardised way of collecting information can be set up. Good examples for creating consensus are the European Food Sustainable Consumption and Production Round (www.food-scp.eu) the table initiative and the development of **data bases for and open access** (e.g. European reference Life Cycle Database (ELCD), http://elcd.jrc.ec.europa.eu/ELCD3/).

Manufacturing Operation Systems (MOS), linking the processing with the business systems and initiatives like the Supply Chain Operations Reference model (SCORE)-model linking business processes and supply chain management⁹, may be key factors for developing systems for more segregated environmental information, thus creating options for increased transparency.

**Terms of trade**
The Fair Trade Labelling Organization (FLO) includes a minimum price and fairtrade premium table that specifies:

- the product (e.g. fresh fruit)
- type (e.g. pineapple)
- quality (conventional or organic)
- form
- characteristics (e.g. dried or fresh fruit)
- country/region
- certification scope (e.g. small producer level)
- price level
- unit, currency
- fairtrade minimum price
- fairtrade premium
- date of validity.

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⁹ The version 9.0 includes capabilities and features to aid environmental sustainability through Industry best practices and metrics to measure the effects of greening, including carbon and environmental footprint, emissions, energy costs and waste. (www. supply-chain.org (accessed October 2010)).
Transparency in the Food Chain

Fairtrade Minimum Price and Fairtrade Premium are set specifically at either country, regional or global level. The provision of the minimum price and fairtrade premium table results in a high level of transparency. Less transparent is how the prices were agreed (and the extent of processes and participation involved in price setting). Greater transparency might be achieved with the inclusion of information of the minimum prices actually paid to producers and the Fairtrade premium received. This would enable information regarding the difference between the minimum price paid to producers to be generated and further, to consider the extent that the minimum price may have become the maximum price.

Standards relating to the length of contract and terms of trade other than price, provide minimal information. Information does exist on the amount of notice required and due dates of payments, but this applies to specific producer-commodity situations (FLO). Likewise, information exists on exactly what is included for the price – for example, packing requirements and provision of transport for goods.

In contrast, Rainforest Alliance and Traidcraft do not include information on the minimum price standards. Traidcraft is however a member of the Fairtrade Foundation, which is, in turn a member of FLO. While not stating specific prices, Traidcrafts’ purchasing document contains a definition of fair price and payment terms are stated. There is no information on the actual prices paid to producers or the minimum prices paid to producers by suppliers involved with Traidcraft or Traidcraft itself.

Working Conditions

Working conditions cover a range of issues including:

- health and safety
- treatment of workers (non-discrimination)
- provision and use of materials relating to work (e.g. sanitation and protective clothing)

Transparency regarding workers conditions and pay has gradually increased as fair trade scheme owners have sought to include standards that address issues pertinent to workers (and not only producers). This attention to workers has also been prompted by Fairtrade sourcing from large producer organisations and plantation sites of production (e.g. bananas).

The Ethical Trading Initiative (ETI) however represents a scheme that focuses entirely on workers. As mentioned previously in the discussion, ETI shares information on a business-to-business level. For the Rainforest Alliance, the standard of the humane and dignified treatment of workers is principle-based and therefore potentially less easy to monitor. One has to consider the evidence that would be required for compliance to demonstrate that the standard has been fulfilled. This makes independent verification, indicators on the participation of workers in decision-making on the ‘shopfloor’, and the involvement of worker organisations to represent interests of workers, considerably important sources of information. All certification schemes except GlobalGap cite standards that promote and encourage the creation of workers’ organisations, trade union membership. Non-discrimination in the workplace is also a common standard within these schemes.
Minimum wage rates are the subject of many standards suggesting that wage rates should be set at the national minimum wage. Again, verification of information is significant and the provision of information to substantiate the wage rates paid is required. The technical compliance criterion, where provided (FLO-CERT), does not include information on the methodology used by auditors to ascertain that correct and fair wages are being paid. A long term and in-depth approach to transparency is needed to enable comparisons of wage rises over a particular time period. For the consumer, the provision of wage levels paid to workers requires a context in order to evaluate the value of the wage and therefore assess its ‘fairness’ and social and ethical dimensions. Such a context requires both the inclusion of information relating to the local cost of living as well as local and national wage averages.

**Social capital and community cohesion**

Transparency in the context of social capital and community cohesion is a significant challenge because it relates to: a) more than individuals (i.e. sole workers) and, b) groups which may not be directly involved with the sites of production. Standards exist however which contribute to the creation of social capital and community cohesion. Traidcraft seeks to ensure that procurement is undertaken in such a way as to not affect concerns of food security. The provision of training for community and producer group members and, the targeting of specific community members (i.e. women’s groups) are examples of attempts to build social capital. The premium price paid to producer organisations aims to offer community benefits through the provision of schools and health/medical clinics (covered by FLO and Traidcraft).

The benefits and impacts of Fairtrade, experienced by growers and producers, although guaranteed by certification, are rarely revealed fully to the consumer – and in some cases, are not clear to the growers and producers themselves. For example, according to Dolan (2010), there is a considerable lack of information about the realised and actual benefits for tea producers from fairtrade. Accreditation organisations, such as the International Social and Environmental Accreditation and Labelling Alliance (ISEAL), are developing a good practice document that may potentially offer a remedy to this information deficit. However, what is not stated by ISEAL is the extent to which its members will share these forms of information.

**Animal welfare**

One problem in discussing (and monitoring) animal welfare is that definitions and assessment of animal welfare are still inconsistent and heterogeneous among researchers as well as within the public. However, a typical overall distinction in applied indicator sets is between animal-referenced parameters and those aiming at the assessment of the animal’s housing conditions. Although animal-referenced evaluation approaches with the focus on ethological, physiological, pathological, and performance indicators enable a direct assessment of the animal well being, they require, apart from a time consuming on-site examination of the respective animals, in most cases expert knowledge or techniques. In contrast to this, the livestock husbandry obligations in relation to what resources are provided for the animal to support its welfare as given by legislative standards and certification schemes open up the possibility to conduct evaluations of the effective minimum animal welfare standard without on-farm visits. Another distinction may be between predominantly views of farmers/ researchers on the one hand and the public at the other hand. In a recent paper
Transparency in the Food Chain

(Tuyttens et al, 2010) it was confirmed that farmers view on animal welfare were more in terms of biological functioning (instead of affective states or natural living) as compared to other citizens, thus any operational definition of animal welfare is unlikely to match equally well with the perception of every single stakeholder group or person.

Basically, the schemes studied here: ‘Freedom Food’, ‘EU Organic’, "Recommended by the Animal Welfare Association", and ‘Global Gap’ follow the procedure of monitoring the resources available for the animal - though through a very detailed assessment of resources available actually monitored at the certified farm to support animal welfare, like space, feed and water. This facilitates also a translation to consumer expectations on welfare issues (possibilities to perform natural behaviour), and is manageable from a resource point of view.

However, it can be argued that these measures support animal welfare but do not assure animal welfare. Therefore, in the schemes ‘Recommended by the Animal Welfare Association” and ‘Freedom Food’ also in some cases clinical assessments on groups of animal are performed when the inspection takes place and/or at the slaughterhouse. However, the outcome of these assessments is not a prerequisite to maintain the certification. Instead, if assessment fall short of accepted standards, it is mandatory for the farmers to take (and document) initiatives to improve the situation. Thus, the assessment serves as feed back to farmers rather than as information to be used in transparency. In fact, no schemes seem to make such information available for the public or to the consumers, and it is not obvious how this information is stored although it is stated that the information should be available for the stakeholders in the production line and the certifying body.

5.2 Crosscutting observations on transparency

The verification, the formal accessibility (openness) of information, the consumer accessibility (ease of understanding) and whether a scheme requires that product identities are segregated (a prerequisite for food chain communication on product item level) were assessed.

The schemes were compared using the indicators for transparency as defined above. Good examples were found to be MSC Fishery Standard Principles and Criteria for Sustainable Fishing considering process oriented schemes and business-to-consumer oriented schemes. For business-to-business communication the Environmental Product Declarations (EPDs), EMAS and the WBCSD/WRI GHG are good examples. Schemes aimed for quantitative measures had a lower assessed transparency. Good examples among these schemes are the EDP that offers open access to both criteria and results (although the extent varies) for business-to-business communication; and, approved by Climatop for business-to-consumer communication.

Most important environmental issues concerning the food chain are accounted for but in different schemes. However, toxicity in primary production is poorly covered with the exception of amount of pesticides. Water usage was not represented in any of the assessed schemes.

For ethical and social issues it is important to recognise that certification schemes translate ethical and social values via management processes within the schemes. Hence, ethical and social values are redefined (and often narrowed) by the management processes that are instituted to govern them.
The consumer accessibility (ease of understanding the information) was not included in the final evaluation since it requires a comprehensive analysis of consumer behaviour and penetration of the issues relating to perceived trust vs. core information, which is beyond the scope of this work.

**Schemes differ in basic features and whom to target**

A number of challenges related to the design and use of transparency schemes were identified as detailed in the previous sections. These need to be addressed in order to continue improving stakeholders’ knowledge of and trust in products, production systems and product chains vis-à-vis their impact on social, ethical and environmental dimensions. The key ideas and assumptions behind the schemes analysed were to document the performance of the aspects of the food systems in focus and – based on the assessments and comparisons - to facilitate continuous improvements on the different criteria (e.g. social, ethical, environmental). This demands that the schemes are clear about which type of data and level of detail they operate on, and how the information provided on product level may be linked with determining improvement options in the relevant part of the product chain. This question is linked to the (differences in) schemes’ ownership, content, structure and types of indicators used. Therefore, the methodological challenges and potential improvements differ between the types of schemes, in relation to the end users and in relation to the attributes discussed above.

**Structure of schemes**

We can distinguish between *process oriented schemes* that focus on describing and certifying the use (or non-use) of certain inputs and practices in primary production and in processing stages, and *quantitative product oriented schemes* that document the actual use of resources and environmental impact per unit of product. Within both these types of schemes some are intended for communication between business partners (e.g. between suppliers and retail chains) while others are intended to inform consumers (end users). Finally, the choice of topics to include seems not to be linked with the type of scheme, except for the fact that quantitative product oriented schemes seem more narrow in the range of topics probably because some aspects cannot be quantified along a product chain (e.g. animal welfare, impact on soil quality).

![Figure 1. Matrix of approaches of classifying schemes (source: the authors)](image)

Figure 1 shows this matrix of approaches with examples of schemes analysed. In the following we discuss specific characteristics of different types of schemes along these two parameters.

*Process oriented schemes*
Process oriented schemes (or criteria based schemes) regulate procedures. They may be implemented on an organisational level or on an operational level. They may be business-to-business (B2B) oriented as well as business-to-consumer (B2C) oriented and are communicated using labels or certificates. The communication is assured by keeping the certified (or corresponding) products separate (segregated) from other products through out the chain. The major difference between the schemes assessed concerns the formal accessibility where, for example, EMAS, MSC and certified Organic Agriculture have open access to both criteria and performance. Good examples from this group of schemes are the Organic label and the MSC Fishery Standard Principles and Criteria for Sustainable Fishing being characterized by open access, third party verification and promote traceability.

Schemes aiming for quantitative measures
Schemes for quantitative measures are all product oriented. They are all based on official standards for calculating the environmental impact, however not all of them require third party verification. All are based on life cycle assessment and thus the data covers the whole food chain up to end user, but only one of the schemes recognises the importance of traceability (segregation of identities), this being the WBCSD/WRI GHG Product Protocol. The formal accessibility varies greatly within the assessed schemes. Good examples regarding transparency from this group are: the EPD, which offers open access to both criteria and results (however, to differing degrees), and the BCSD/WRI GHG Product Protocol system for business-to-business communication; approved by Climatop for business-to-consumer communication and Environmental reports (SE) for business to authority communication.

Business to business communication
The schemes assessed are all verified by third party verification, with the exception of the WBCSD/WRI GHG Product Protocol (any labelling is implemented through other protocols). Good examples for business-to-business communication regarding transparency are the Environmental Product Declarations (EPDs), EMAS and the WBCSD/WRI GHG.

Business to consumer
The schemes aimed for business-to-consumer communication vary greatly in all aspects. The assessed schemes are all aimed towards product differentiation. The MSC Fishery standards are serving as a good example for transparency of information.

Finally, although many schemes do not support transparency very well according to the indicators it is important to recognise that a combination of schemes may be a good solution. For example, all food producers are required to have a traceability system. By combining systems aimed for communicating environmental and ethical concerns with the traceability system a higher level of transparency may be achieved.

5.3 Developing schemes for transparency of environmental, social and ethical concerns
To build transparent food chains requires knowledge and a broad acceptance from the food industry. The process of developing a scheme is important. Svenskt Sigill climate certification may
serve as a good example. The process of developing the scheme started with the state-of-the-art knowledge, involving researchers from the beginning. Stakeholder meetings and open consultations followed in order to create a consensus. The criteria have been developed based on best available scientific knowledge, instead of prejudices on what is good (e.g. "transport is necessarily a bad", "organic production is always better").

Criteria based schemes are often based on guidelines or rules for management such as: use of inputs, actions to use internal resources optimally and to reduce emissions and losses. The assumption made is that following the guidelines will then “guarantee” improved environmental/animal welfare performance, but this is rarely verified by actual measurements on the particular farms. Indicator systems have been developed to assess environmental and animal welfare performance on farms (and along chains), but very few certification schemes have been built around such quantitative indicator sets.

Some schemes, especially schemes having an environmental focus, such as carbon footprint schemes, have a very narrow scope. Considering transparency, broader and scientifically based schemes would be preferable. It is however an open question to what degree environmental and social information should be linked with specific consignments of a product, for example in the same way as is done with food safety information, such as salmonella specifications. Potentially LCA based information on the GHG emissions per kg product could be attached to a product by recording and reporting along the chain following principles for food safety traceability. However, this would require high investments in data recording and handling and further developments in methodological procedures (such as with the PAS2050). Alternatively, more generalised quantitative information at the product level could be sufficient, such as deployed by the carbon footprint. The Sigill climate label builds on a more general approach (guaranteeing processes and practices but not giving quantitative information), which could be assessed by the type of external farm and chain reviews described above.

From a business-to-business perspective, transparency is also about trust, but sharing value chain information may also create more efficient and sustainable food production chains in itself. Thus, schemes for promoting business-to-business communication will most likely be different from systems/solutions promoting transparency for the consumers, as they will need to be more detailed in their information requirements.

5.4 Providing verifiable, accessible and credible information

The level of compliance required to gain certification varies between schemes. FLO-CERT, for example, sets out detailed standards on a range of production topics. Examining the lists of standards reveals that in order for certification to be gained, not all the standards listed are required to be met. Only those marked as mandatory are considered as a critical standard requiring full compliance for FLO-CERT. The 70 broad standards laid out in FLO-CERT’s technical compliance criteria list for Small Producers’ Organisations are accompanied by 215 standards. Of these, only 20

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are listed as a mandatory prerequisite for gaining certification. GlobalGap follows a similar approach with its ‘major must’, ‘minor must’ and ‘recommended’ approach to the compliance of standards. Consequently, it was necessary to consider the process of certification, including the level of compliance required by scheme owners to ascertain the degree to which information on standards reflects reality or aims promoted by the scheme.

Information on how many producers have received certification, however, indicates to some degree, a level of compliance. For example, the Fairtrade organisation FLO cites on their website that there are 746 fairtrade producer organisations in 58 producing countries (and this, according to FLO represents over one million farmers and workers). Again, caution is required, because, in some cases, compliance and certification does not demand 100% compliance to the standard elements publically listed. Indeed, some schemes seek to pursue a flexible approach to the compliance to standard elements in order to include a greater number of small producer organisations to the benefits of Fairtrade (for example, Traidcraft).

It is important to differentiate between standard elements that require compliance and those that are optional; the latter may indicate an aim of the scheme rather than an actual practice occurring as a result of compliance. This does not apply to the Ethical Trading Initiative (ETI) that uses an approach based on cooperation and flexibility rather than compliance and certification per se. Similarly, the process of certification used by Rainforest Alliance relies on a ‘scoring’ method in which a producer organisation is required to comply with a percentage of the standard elements.

Transparency cannot be read off from standards within certification schemes alone. Processes of verification of information, especially relating to the level of compliance required to gain certification (including ongoing monitoring of compliance) become critical for transparency. FLO-CERT, GlobalGap, EU Organic farming, and RSPA-freedom food all disclose significant amounts of information on how standard elements are translated into auditable forms and verifications. For example, these schemes publically share lists of ‘technical’ compliance which detail the precise measures needed to be undertaken to meet the standards and achieve certification. Notably, so far, only GlobalGap and FLO-CERT share publically the lists of technical compliance that effectively translate the broader standards outlining the principals and intent of schemes into ‘tick box’ lists of compliance standards. This process is illustrated more succinctly in Figure 1:

![Figure 2. The process of standards and compliance (source: http://www.flo-cert.net)](http://www.flo-cert.net)
Creating a criterion in which to assess transparency on a set of key topics enables comparisons to be made within a certification scheme and between one or more schemes. Comparisons are limited, however, because the structure and size of organisations differs significantly (e.g. Traidcraft and FLO). In addition, some schemes provide information relating to technical compliance as well as standards. The increasing convergence of standards results in the harmonisation of standards and information. Put another way, the presentation of standards by organisations does not necessarily represent transparency.

The provision of credibility, accessible and verifiable information is paramount in achieving transparency. One main approach adopted is through the provision of verifications to prove compliance to the standards. This includes:

- results of audits and certification processes, which disclose information on the regularity of compliance-based checks,
- the topic areas covered by compliance and,
- the levels of compliance and non-compliance.

Levels of compliance and results of monitoring are, for most part, unavailable to the public because certification issuers follow a protocol that seeks to provide elements of commercial protection for producers. In addition, detailed information relating to the methodology in certification processes remains confidential to protect intellectual property (Fuchs et al 2010:11). FLO-CERT acknowledges this dilemma of transparency. FLO-CERT expresses their commitment to the confidentiality of operators’ information yet claim that “because most operators know that transparency is crucial to the Fairtrade system, most operators agree to the release of some information”.

The difficulty of creating performance-based transparency is a reason for the development of the process that ensures that information is credible: accreditation. Processes of accreditation aim to confer independent approval of standards set by certifiers and associate organisations. Essentially, the logic behind accreditation is quis custodiet ipsos custodes? – who watches the watchmen?

An organisation fulfilling this role of conferring approval is the International Social and Environmental Accreditation and Labelling Alliance (ISEAL). The ISEAL Alliance is an organisation that describes itself as a global association for social and environmental standards. ISEAL works by advising certification schemes and conferring independent approval. This, it is argued, contributes to the credibility of the standards of certification schemes. The ISEAL Alliance operates by working with its member organisations to develop credible standards. (Two members organisation of ISEAL who are included in this review are FLO and Rainforest Alliance). ISEAL develops codes of good practice that are implemented by the member organisations, for example, the Code Of Good Practice For Setting Social and Environmental Standards. In 2010 the ISEAL Alliance began to develop a Code of Good Practice for Assessing the Impacts of Systems (Impacts Code) and has also expressed its intent to develop a Verification Code of Good Practice in the near future. This indicates that greater attention towards capturing information relating to impacts of standards will be made in the future.

11 http://www.flo-cert.net/flo-cert/main.php?id=33
The Global Reporting Initiative (GRI) describes itself as a network based organisation that has developed a sustainability reporting framework. According to GRI, the framework sets out the principles and indicators that organizations can use to measure and report their economic, environmental, and social performance. Traidcraft follows GRI Quality of Information Principles as criteria for evaluating performance information. The GRI sets out the following as key to underlying the principles for ‘effective transparency:

- reliability
- clarity
- balance
- comparability
- accuracy
- timeliness

GRI specifies two types of disclosure\(^1\) that are required within reports produced by organisations such as Traidcraft. The first relates to management and seeks to reveal how an organisation approaches its aims and more about its organisation. The second is the provision of performance indicators that “elicit comparable information on the economic, environmental, and social performance of the organisation”.

The role of technology

The information used to assess transparency in the writing of this chapter relies on information accessible by the internet. This in itself suggests that technology is important in facilitating information and aiding transparency. Fuchs et al (2010: 6) makes a similar point suggesting that “transparency is also subject to technological and financial constraints”. Two examples can be provided of how technology and traceability, as a corollary of transparency combine to offer insights in relation to social and ethical concerns.

CARETRACE\(^1\) uses technology to bring consumers and producer organisations closer. Using an internet based product-tracking scheme, consumers are able to match their product with a specific geo-region and producer and access information on the livelihood and community experiences of the producers involved with growing their purchased commodity. CARETRACE utilises technology and the existing embedded traceability systems to create transparency. Sceptics might argue however that transparency is selective (for example, the basis on which producers are included is not clear) and independent verification is limited.

A further example of the role of technology in aiding the facilitation of transparency is drawn from Sedex (Supplier Ethical Data Exchange)\(^1\). Sedex uses internet technology to create a platform in which allow businesses and suppliers to share social and ethical data. Technology, in this example, is used to enhance accessibility and prevent duplication of information. Note however, that Sedex


\(^{13}\) www.caretrace.com

\(^{14}\) www.sedexglobal.com
Transparency in the Food Chain

claims it is not an accreditation body nor does it sets standards. It is an organisational tool of transparency based on technology.

**Transparency on demand**

Integrity of the food chain is intimately linked with the ability to create trust and the actual information available. It is, however, important to recognise that this information will vary according to the situation, time, policy, focus of the general debate on food and so on. To create a persistent system that quickly can adapt to new situations requires a thorough understanding of what are the formats of the schemes that promote transparency.

An important question that has come up during this study is: how much of the available information needs to be open? Obviously there is information that is very sensitive for a company from a business point of view. A fully open system is most likely not realisable both from a commercial confidentiality perspective and on account of the huge amount of data (e.g. LCA background data) and qualitative information to handle. In other words, how can more transparent food chains be achieved?

From a consumer perspective, transparency is about creating trust. Thus, fully open systems may not be needed. “Transparency on demand” may be solutions where information is, for example, retrieved from a third party (e.g. a database containing confidential company specific data) and processed on demand to a format being acceptable and understandable for the customer without the need to share sensitive business information. Here the moves by ISEAL to promote standardized assessments may preface the development of such a two step process of transparency. From a business-to-business perspective, transparency is also about trust, but sharing value chain information may also create more efficient and sustainable food production chains therein. Thus, environments/systems/standards for promoting business-to-business communication are likely to be different from systems/solutions promoting transparency for the consumers, by being more detailed. Sharing value chain information thus requires trust across the food chain and this is another major challenge that needs to be addressed.

6 **Need for further development**

As presented above the wide variation between schemes in approach and coverage of thematic issues partly reflect that this area is immature and still evolving in terms of the understanding and application of critical steps in forming coherent transparency schemes which again is linked with insufficient knowledge of efficient ways to create trust and to what extent the schemes are fit for purpose. In the following we discuss important areas of new knowledge needed for the transparency schemes to be further developed.

6.1 **Improved transfer of integrity characteristics within a chain**

**Traceability reference unit**

It is not trivial to set the relevant traceability or reference unit in food systems in relation to the integrity parameters. Intuitively - in the simplest case - one might see the fresh produce grown at a given season at a particular farm as the relevant unit. However, in establishing, for example, the carbon footprint of products through a life cycle assessment (LCA), one will need information on the carbon footprint related to some inputs used, for which there will be no seasonally specific
information. The LCA approach requires estimates on material balances involved and information on how these contribute to a given impact category. Generally the impact calculations are (and will have to be) based on a limited number of fairly accurate measurements from the foreground system, which are combined with data obtained from data-bases for the background systems being included. If data are not available, which often is the case, assumptions must be made by making use of data for similar processes/products or by modelling. Thus, there is a need to continue to establish and harmonise product specific guidelines for what needs to be estimated based on the product specific data and which data from acknowledged databases can be used. In addition, it is not a simple exercise to set the system boundaries for the background information.

The situation will be even more complex in systems of continuous production like livestock products. For example, in pig production different batches of production may have quite different histories. Will it be relevant to use the batch (not talking about the individual animal) as a reference unit knowing that probably most of the integrity parameters are sought to reflect more long-term impacts? This also goes for the processing unit and ultimately is a question of what is relevant to stakeholders and for what purpose. Moreover, in processed foods with a large number of ingredients, there may be ‘too many’ foreground farm systems to give meaningful representation of all specific product lots used. There is presently no well-developed definition of appropriate time and scale boundaries for the integrity dimensions leaving too much freedom to the individual scheme owner in setting these criteria that, in fact, makes informed choices difficult for the inexperienced user of that information.

Thus, in order to facilitate transparency and harmonize procedures across food chains, there is a need to establish a sound, manageable and robust framework that points out the relevant aspects to take into account when choosing the traceability reference unit in different types of food chains and covering different integrity dimensions in order to harmonize indicator calculation.

Methodology to reflect the integrity dimensions
For the long term impact (and for enhanced trust) it is imperative that there is coherence between what stakeholders perceive as being “covered” by a claim and how the food chain actually impacts on the integrity dimension in question. There are, however, huge differences in how accurately and how comprehensively the different dimensions can be assessed. While concepts of dimensions like energy use and carbon footprint are well developed and can easily be assessed (under the assumption of access to data and choice of the relevant reference unit as detailed above), concepts for other dimensions like animal welfare and terms of trade are less easy to define. Presently the certification schemes translate ethical and social values to relatively simple indicators and/or guidelines, which may be very narrow in scope. E.g. in the EU Organic Food scheme animal welfare is deemed superior to non-organic animal welfare because the space supplied to the animals is larger than the legal requirements and the housing form and the access to outdoor areas let the livestock perform more of their natural behaviour. However, no evaluation of the state of the animals is performed. While the increased space basically should support the welfare of the animals, a number of events and conditions in the particular housing system may counteract this, and it may be quite possible to observe animal welfare problems at a farm that fulfils the space criteria set.
Another example is terms of trade (Fair trade labels) where relevant standards have been fulfilled, but in fact it is not documented that the producers involved in the schemes experience a better livelihood than they would otherwise have had (given that is probably what is expected for by the consumer). It is important to be aware of these drawbacks of the indicators presently used. On the one hand, narrow indicators may be easy to define, but on the other hand they may not reflect what is asked for. Furthermore, the more narrow the definitions that are used, the higher the risk that efforts will focus on how to optimize those indicators rather that on measuring the actual impact. In addition, it may also contribute to a so-called “burdens shift” – that is, reducing one indicator leads to the increase importance of another. This may in turn lead to “scandals” or credibility losses in relation to certification and in the longer term undermine the efforts being made.

There is a need to take stock of the quite comprehensive research activities within indicator development and to assess critically the indicators presently being used in schemes, and based on that, to establish sufficient, comprehensive indicators that reflect the impacts aimed for in the different integrity dimensions.

Access to relevant information in performance based schemes

In performance based schemes, like the carbon footprint, the information related to a product basically needs to be present at each point of processing and or redistribution in order for final assessment of the product presented to the consumer. Thus, in principle the information (values and principles for calculation) can be stored and made available to all within the chain and outside the chain. However, some parameters may contain protected knowledge, which the company may not want to share, and – apart from the aspects of verification of the numbers - it may have little appeal to end users. The challenge here lies in establishing a shared data exchange system that is available to a range of users and from where different users of a defined product can draw information for further processing.

Such a data exchange system should ideally also contain the relevant information necessary for impact assessment of the very typical resource use like electricity and transport over which the food chain actor has no control, ensuring that all actors using the same resource also assess the impact the same way equally. Private and public databases that can support such uniformity in impact assessment do exist (like the private Ecoinvent database and ILCD) and rules for assumptions and calculations for carbon footprint exist, like PAS 2050. However, it seems that the technology and principles used are not sufficiently robust to ensure that these are “Gold Standards”, and sufficient to avoid strategic misuse of calculation methods to “greenwash” products.

Aggregation of information and data is necessary in order to communicate information to consumers in an understandable way. The aggregation of selected information and the formation of a signal are based on “choice editing”, e.g. by the owner of a signal/label. Aggregation of data on the other hand means loss of detailed information and also a decrease in transparency. An approach to handle these two somewhat contradictory aspects is needed. A way to establish transparency with a “reasonable backpack” that can handle both information and data may be the setting up of a network of access points where data can be accessed before aggregation (e.g. web page linked to the producer showing the relevant contribution to the integrity indicators). Thus, there is a need to
find cost efficient systems for data sharing that allow connection to a relevant reference unit, a timely and transparent update of process information and a reasonable degree of open access for all interested parties.

Data for improved transparency and for benchmarking within rule based schemes
In process-based schemes all producers fulfil a set of minimum requirements, which are generally publicly available for the interested user. The verification of the fulfilment is generally carried out through an inspection process by an accredited certification body. In order for the inspector to judge compliance with the certification criteria, a range of information is collected. E.g., in order to judge the space allowance per animal the actual space allocated to the animals at a particular farm needs to be monitored, or in order to judge if minimum wages are paid to workers the actual payment in the concrete situation needs to be recorded. In the schemes we have assessed, this information, however, is not accessible for persons outside the certification body. This limits transparency in two ways. Firstly, in some schemes, e.g. Global G.A.P., an overall compliance rate with the scheme is a prerequisite for certification, but it is not transparent which criteria that are not fulfilled in the individual cases. Secondly, it is not possible to evaluate or compare the performance of different producers/food chains within the same scheme.

Furthermore, while acknowledging that often quite advanced systems are in place to ensure a continued development in criteria in many schemes with inputs from industry and NGOs, the lack of transparency of the inspection results prevents the ability of producers within a scheme making use of benchmarking to improve their integrity results, with the associated value this superior performance can add in marketing terms and so on. This highlights the need for more effort to be made to identify barriers and opportunities for making inspection results publically available in a meaningful way.

Key performance indicators
Some of the complexities in evaluating the integrity of the food chains are related to monitoring and keeping track of the integrity characteristics throughout the food chain. However, it seems that in many cases the major impact for a given category takes place in or at a specific stage (or at a few steps) of the chain. Better insight in how the different steps actually impact on the integrity aspects for different foods/food chains, and where there is room for manoeuvre for the producer, may facilitate more simplified data handling and at the same time allow a more detailed assessment of the particular aspect in focus.

6.2 Independent and integrated external assessment of integrity of food chains
The research needs identified until now follow the idea that the information is created and handled within the chain and among the chain actors. The problems occurring are related to the fact that relatively narrow indicators have to be used for practical reasons, identifying relevant time and scale frames, data handling, and verification, besides the fact that the integrity dimension cannot be monitored on the product as such. However, most integrity dimensions in reality are seeking to address more long term and societal concerns and are less allocated to the very specific batch of a product, which is important when considering the safety of the food product.
Furthermore, from a consumer perspective, transparency is about creating trust (and the task of the monitoring system is to make sure that this trust is justified). Thus, fully open systems may not be needed. “Transparency on demand” may be a solution where information is retrieved from a third party (e.g. a database containing confidential company specific data) and processed on demand to a format being acceptable and understandable for the customer without revealing sensitive business information.

Most schemes – especially the new private labels – have so far not been studied extensively and there is a lack of knowledge of how much these schemes and their rules and practices actually impact on externalities in the chain. The Code of Good Practice for assessing the impacts of social and environmental standards systems elaborated by ISEAL Alliance in time may improve the level of knowledge. The European Commission has also recently published an “EU best practice guidelines for voluntary certification schemes for agricultural products and foodstuffs” designed to describe the existing legal framework and to help improving transparency, credibility and effectiveness of voluntary certification schemes. However, there is still a need to relate to the issues previously mentioned regarding time and scale delimitations and in particular to justification of how rules can be translated into quantifiable impacts.

Following this path of thinking, we can identify a need for a critical review on how existing indicators (more comprehensive than those that are used in present labelling schemes) for integrity dimensions (animal welfare, working conditions, environmental impact) translate into true impacts that can be communicated to the consumer. Also there is need for the establishment of criteria to be used in guidelines for external reviews and assessment of schemes in order to facilitate comparability between schemes and over time. Last, but not least, there is a need for having more certification schemes scrutinized and assessed regarding their true performance.

7 Conclusion
While important efforts are being made by private and public bodies to improve transparency of food chains, some basic requirements are still not met and need further research. These are related to identification of the relevant traceability reference units, how indicators can be improved to better reflect the impact envisaged to be reflected, and how the data handling infrastructure can be improved – also in relation to the costs.

Furthermore, an alternative way of creating sound consumer trust - compared with a systematic transfer of information through the food chain on a daily basis - should be considered. Given the fact that the integrity ‘quality’ cannot be monitored in the product as such, and that most integrity dimensions in reality are seeking to address more long term and societal concerns (as opposed to food safety where it is important to know the exact status of the very particular product), it might be as effective to make a regular independent assessment of foods chains in relation to integrity aspects. This may be explored in more detail.

## III COMMUNICATION

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16 Earlier version published as deliverables within the EU project Transparent_Food:  
D5.1 Report drawn from data collection and review and stakeholder participant workshops on the breadth and range of certification systems and labelling schemes signalling information to consumers and the strengths and weaknesses of these systems and signals  
D5.2 A meta-analytic roadmap of consumer requests, contexts for such requests and priorities
A CERTIFICATION SYSTEMS AND LABELLING SCHEMES
SIGNALLING INFORMATION TO CONSUMERS

ABSTRACT
This chapter evaluates the variety of forms and methods of signalling information to consumers about their food purchases from a stakeholder perspective. Stakeholders in this chapter include: certification scheme owners, manufacturers, retailers, non-governmental organisations and producers. The chapter draws on perceptions and experiences of stakeholders to evaluate the effectiveness of systems for producing and transmitting signals about food to consumers and from business to business. Particular attention is given to the strengths and weaknesses of certification schemes in signalling information to consumers.

Logos and the certification schemes they represent are regarded as being a significant tool in communicating information to consumers by stakeholders. Moreover, certification schemes enable retailers and non-governmental organisations to meet their own agendas and aims, especially in the context of environmental impacts and sustainable food production. Third party independent certification schemes were considered by stakeholders as critical in ensuring the validity and credibility of information signalled to consumers. Indeed, stakeholders such as retailers, manufacturers and certification scheme owners cooperate over some signalling issues to effectively communicate messages to consumers.

Signals highlighted by stakeholders as being especially challenging to communicate to consumers were food safety, origin, environmental impacts and sustainability and, animal welfare. The reasons for this however were diverse. Consequently, certification schemes were identified as tool to overcome the anomalies arising from legislation.

The management of signals by stakeholders is a further focus of this book. The management of signals involves particular practices of information editing. Information editing in this context refers to the use, presentation and accessibility of information and the editing of information by stakeholders. Information editing enables stakeholders to develop coherent signal narratives about their food products and to maintain the difficult tension between offering too much and too little information to consumers. As a result, the pressure to provide information can, be reduced, in part, by the choice editing of products sold. A further development is the supply chain management by some retailers and manufacturers. In one case, this choice editing reaches back down along the supply chain in terms of setting sustainability criteria for all procurement choices. These emerging realities in contemporary food chain management need to be incorporated into our understandings of the current state of food chain transparency.

Finally, non-label provision of information is regarded as a further means to overcome the spatial and temporal limitations afforded by label based methods of information transmission. Non-label provision of information invariably occurs post-purchase and includes access to telephone care lines and websites. Stakeholders reflected on the possibility of future signalling practices which will, according to them, increasingly rely on technology at both the point of purchase and post-purchase. Signalling information may involve using hand held devices and greater use of RFID technology in the future. This will also make greater use of traceable information.
1 Introduction

This book draws on stakeholder discussions to answer the following key questions:

- What are the stakeholders’ (retailers, manufacturers and producers) perceptions and experiences of signal information about food to consumers?
- What are the strengths and weakness of signals based on certification schemes such as logos?
- What additional methods and practices are used to transmit information to consumers about food? How are these alternative approaches enacted, for example, by corporate social responsibility agendas, in store campaigns and brand management?

The questions reflect an intention of the book to assess the effectiveness of using logos based on certification schemes based on stakeholders’ perspectives and experiences. Recognised within the approach to this deliverable is that logos are one of a multitude of ways to inform consumers about food. Moreover, not only does diversity exist in the range of methods but also in the types of signals sent to consumers.

In addition to exploring what methods of information transmission are effective (and why), the book also investigates what the stakeholders are seeking to achieve and the value of sharing and transmitting of information. For example, the motivation underlying the move to transmit information may not be related to a product itself but is instead part of a broader strategy linked to a company’s broader corporate social responsibility agenda.

1.1 Methodology

Our tasks in this deliverable focused on collecting and analysing data on current food industry practices and experiences of systems for producing and transmitting signals about food to consumers (with particular attention being paid to the retailers). The development of certification schemes and the variety of forms and methods that the signals are presented to their consumers by food value chains were collated (appendix 1) and analysed to present breadth of practice and experiences of the industry and of food certification schemes. Discussions and interviews with stakeholders provided the opportunity to elicit views of the strengths and weaknesses of their systems and identify challenges around specific signal types as well as share ideas around best practice.

1.2 Signal Categories

Producers, manufacturers and retailers seek to communicate a range of messages about to consumers. Such signals may include information relating to quality, food safety, price as well as signals that seek to elevate their own position against market competitors. In the Transparent_Food project however, the focus is on exploring what types of information exists along the food chain and the methods and forms of transmitting that information. Consequently, there is less focus on signals that relate to business practice and integrity or
competitive behaviour (such as price differences, brand values and meaning). This distinction is both subtle and challenging because information concerning food and food practices is used to enable competitive advantage and brand integrity awareness. In other words, brand strategy for say, a global manufacturer or a corporate retailer, can incorporate the utilisation of third party certification schemes with their respective logos as well as other food supply management to provide signals and messages about their food product offering to consumers.

The different types of signals are as numerous as the methods and systems used to transmit signals to consumers. The types of signals can be broadly categorised under the headings of 1) Food Quality (including composition and food safety) and 2) Food Integrity. Table 1 provides a definition of each type and sub-type of signal identified in this chapter.

Examples of the different types of signals enacted in certification schemes are provided in Appendix 1. This list illustrates the range of certification and assurance schemes and identifies the types of signals generated from each. The approach used to classify schemes in Appendix 1 is based on the primary and secondary signals sent to consumers. The inclusion of the category ‘secondary signals’ in the table is in part recognition that that some schemes may seek to signal that they incorporate more than one aim within the scope of their scheme. For example ‘organic’, as a signal communicated to customers via a logo, may be underpinned by a certification process that includes a focus on animal welfare, ethical and fair treatment of workers as well as environmental goals such as maintaining biodiversity. The signals reflect a qualitative evaluation of what the organisations claim as the aims and associated standards they adhere and align themselves to. The classification and categorisation of signals devised in this document relies on information displayed on scheme owners’ website17. Having identified the types of signals that are communicated to the consumers, the next section focuses on the methods of signal transmission, for example, non-label and label methods of signalling to consumers.

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<tr>
<th>Signal Area</th>
<th>Definition and background</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOOD QUALITY</td>
<td></td>
</tr>
<tr>
<td>Food Safety and Food Quality (Composition)</td>
<td>In the UK, public food scares and concerns (e.g. BSE and salmonella outbreaks) have contributed to the emergence of schemes which seek to visibly assure food safety. British Lion Quality (eggs) and Assured Food Standards (AFS) are two prominent examples of certification schemes that use logos to indicate assurance that a set of standards has been met. Food safety is a signal which seeks to assure consumers that food has been produced, handled, stored and prepared to meet standards which fulfil regulatory requirements concerning food safety and is safe to eat.</td>
</tr>
<tr>
<td>Nutrition and Health</td>
<td>Nutrition and health signals concern information relating to the nutrition content of food such as fat, sugar, and guidance on advice regarding the recommended daily amounts of each. Signals under this heading may also aim to send messages that promote responsible drinking or a healthy and balanced diet.</td>
</tr>
</tbody>
</table>

17 The Information on which the categorisation of signals is based is correct as of when visiting certification websites.
**Food Quality**

Quality is a matter of definition and is closely linked with other categories of classification listed here. For example, quality can be conceived as an attribute when a product possesses an attribute valued by the consumer. This attribute of quality might be linked to the process and method of production (such as environmental impact of product or place of origin and provenance), the organoleptic merits of a product or an assurance that a particular set of standards has been met throughout the chain of production.

**FOOD INTEGRITY**

**Origin**

Origin as a signal concerns information about the origin or provenance of food. At first sight, the meaning of the origin as a signal should be reasonably comprehensible. Confusion may arise however due to different sites of production in the rearing/growing, processing, manufacturing and packing of food. Thus, composite foods may be multi-origin. Furthermore, traceability systems used along the food supply may be used to signal information concerning food safety around origin.

**Environment – Process Production Method and Impacts**

Environmental signals are diverse and encompass a wide range of production and processing issues. Signals linked to environment may focus on a particular type of production method process that seeks to minimise or manage environmental impact. A case in point to illustrate this is the Soil Association which promotes and signals organic production method. Another example is the Leaf Marque that represents a scheme that follows practices of integrated farm management seeks to signal to the consumer that biodiversity and the limited use of pesticides has been maintained throughout production. This approach to production contrasts to organic farming but nonetheless both relate to environment-based signals. Finally, while some signals to communicate information linked to production method, other signals seek to provide information on product impacts – such as carbon footprint labelling and sustainable sourcing policies.

**Ethical and Social: Animal Welfare**

Signals linked to animal welfare seek to provide assurance about the welfare of animals, for example, livestock from rearing to slaughter.

**Ethical and Social: Fair Trade**

The messages behind fair trade signals aim to indicate to consumers that fair trading practices, for example, fair prices for producers and suppliers have been paid and fair contractual terms have been agreed. In addition, fair labour practices, such as wage and working conditions may be included in signals under this category.

**Cultural and Social**

Cultural and social based signals inform consumers about the suitability of foods for those whose dietary requirements are based on social and cultural practices, for example, Kosher, Halal or vegetarian.

1.3 Label and non-label based signals

Information intended for consumers can be communicated in a range of ways. Information can be signalled to consumers at both the point of sale, in the space-of-sale – for example, in-store and, virtually, via websites. Labelling is a method of communicating information to consumers via the product itself.
The broader processes of transparency and signalling to consumers are illustrated in figure 1 and figure 2. Signals are suggested to be either label or non-label based. The different modes of signalling are captured (e.g. retailer or manufacturer led) as well as the distinction between mandatory information and voluntary information. Figure 2 (non-label based signals) complements figure 1 as it continues to focus on signals to the customer/consumer. Figure 2 illustrates the types of signals which are non-label based i.e. are transmitted via means other than the product itself.

Label based signals can be based on a mix of mandatory and voluntary labelling. One area exemplified in figure 3 and figure 4, are the signals that are linked to health and nutrition related information. As figure 3 and 4 illustrate, some signals are regulated by mandatory legal labelling requirements, for example, the inclusion of information on the food label about allergens. Directive 2007/68/EC details the list of 14 ingredients that are identified as allergenic\(^\text{18}\). Clear labelling indicating that products contain these products is required under the Directive. With regards health claims, EC Regulation No 1924/2006 is the regulation for which accordance of all approved health claims is required. General claims about benefits to overall good health, such as 'healthy' are only allowed if they are an appropriate and approved claim. Council Directive 90/496/EEC on Nutrition Labelling of Foodstuffs regulates the labelling of the nutrition content of foods.

\(^{18}\) Allergen labelling also represents the signalling of food safety.
Transparency in the Food Chain

Figure 1: Label-based signals

Key: The yellow boxes represent the signals and logos which might be present on a label. The light green boxes represent information that is obligatory. The black dashed line indicates how two forms of information can be interlinked i.e. from retailers and manufacturers. The darker orange boxes below the light yellow boxes represent certification processes. The red dashed lines represent business to business transparency.

- Customer
- Product category
- Label(s)
- Product
- Examples of signals and of certification
  - Social and ethical e.g. Fairtrade
  - Food safety and assurance e.g. Red Tractor
  - Environmental impacts and sustainability e.g. Rainforest Alliance, Carbon Footprint Labelling
- Certification & auditing
- Regulation of auditors and certification process
- Mandatory signals governed by a range of EU legislation
  - Origin
  - Health Claims
  - Dietary related & health
  - Ingredients
  - Nutrient Content
- Retailer-led brand
- Manufacturer-led brand
- Durability
- Ingredients
- Nutrient Content
- Production and Processing
Transparency in the Food Chain

Figure 2 Non-label based signals

Key: This chart focuses on non-label based signals to the consumer. It shows the range of spaces used by retailers and manufacturers to communicate information to consumers about products and production processes along supply chains. Corporate Social Responsibility reports, available on websites, are an opportunity in which retailers and manufacturers showcase examples of best practice of production and processing and indicate progress on a range of environmentally sustainable-based aims.
**Transparency in the Food Chain**

**Figure 3 Mandatory and voluntary health and dietary related signals**

### Allergen Advice – Mandatory

Directive 2007/68/EC details the list of 14 ingredients which are defined as allergenic. Article 14 of EC Regulation 178/2002

- Celery
- Cereals containing gluten (wheat, barley, rye and oats)
- Crustaceans (lobster and crab)
- Eggs
- Fish
- Lupin
- Milk
- Molluscs (mussels and oysters)
- Mustard
- Nuts
- Peanuts
- Sesame seeds
- Soybeans
- Sulphur dioxide and sulphites (above 10 mg per kg or litre)

### Health Claims – Mandatory

General claims about benefits to overall good health, such as ‘healthy’ or ‘good for you’ will be only allowed to be used if accompanied by an appropriate and approved claim. Health claims are governed by EC regulation No 1924/2006. Annex of EC Regulation 1924/2006 sets out specific terms.

- Examples of nutrition claims: low energy; energy-reduced; low fat; fat-free; low-saturated fat; low sugars; sugars-free; low sodium/salt; source of fibre; natural/naturally

### ‘Specialist Diet’ – Voluntary

Claims regarding suitability of food for vegetarians are underpinned by what is known as a ‘voluntary claim’. This means it is illegal for the labelling information to include anything that is false or likely to mislead. Recently, Article 35 of the proposal for a regulation on the provision of food information defines the context in which the terms vegetarian and vegan may be used.

- Examples include: kosher, vegetarian, vegan and halal
**Figure 4 Dietary and health-related signals**

**Dietary and health related signals:** voluntary

**Key:** This chart illustrates the different forms of nutrient content based signals and provides examples of the formats in which they are presented in the UK.

**Notes**

Nutrient based signals are voluntary. The GDA approach was developed by food manufacturers and retailers.

The FSA (UK) advocates the ‘traffic light’ approach.

In addition, information may signal to consumers that the product is one of their recommended ‘5 a day’. E.g.

**Guideline Daily Amounts (GDA)**

-Front of pack

-Guidelines about the approximate amount of calories, fat, saturated fat, carbohydrate, total sugars, protein, fibre, salt and sodium required for a healthy diet.

**‘Traffic Light’**

-Front of pack

-Macronutrient advice on fat, saturated fat, sugars and salt.

**Nutrient Table**

-Back of pack

-Indicates the amount of energy.

**‘Sole’ Nutrient Based Signals**

-'Low in fat' and ‘reduced fat option’

-'Low Calorie’

E.g. Waitrose

**Each pack contains**

This is the number of calories per serving, e.g. pack.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>GDA</th>
<th>Traffic Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>1345</td>
<td>15g</td>
</tr>
<tr>
<td>Protein</td>
<td>10g</td>
<td>15g</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>25g</td>
<td>15g</td>
</tr>
<tr>
<td>Fat</td>
<td>2g</td>
<td>15g</td>
</tr>
<tr>
<td>Saturated Fat</td>
<td>1g</td>
<td>15g</td>
</tr>
<tr>
<td>Salt</td>
<td>0.6g</td>
<td>15g</td>
</tr>
<tr>
<td>Sugar</td>
<td>0.6g</td>
<td>15g</td>
</tr>
<tr>
<td>Calories</td>
<td>275</td>
<td>15g</td>
</tr>
</tbody>
</table>

*Note:* This chart illustrates the different forms of nutrient content based signals and provides examples of the formats in which they are presented in the UK.

*Notes*

Nutrient based signals are voluntary. The GDA approach was developed by food manufacturers and retailers.

The FSA (UK) advocates the ‘traffic light’ approach.

In addition, information may signal to consumers that the product is one of their recommended ‘5 a day’. E.g.
2 Stakeholder perceptions

This section of the book focuses on the perspectives held by stakeholders on the topic of signalling information to consumers. Stakeholders include certification scheme owners, producers, manufacturers, retailers and NGOs/CSOs. The key themes explored in this section include: the challenges involved with signalling information to consumers, the strengths and weaknesses of using certification schemes and their associated logos to signal information to consumers and the challenge raised by specific types of signals. The challenges raised by specific types of signal include: animal welfare, environmental impacts of food production and process, sustainability and origin. This section also reveals an emerging approach taken by stakeholders in response to the limitations and challenges of signalling via logos and labels. This concerns the role of stakeholders, in particular, retailers and manufacturers in managing signals through strategies of information-editing and choice editing. Best practice alternatives to logos and labels are discussed, for example, the non-label provision of information to consumers. Finally, some thoughts, expressed by stakeholders, on the future of transparency and signalling are discussed.

2.1 Signalling to consumers: Key constraints and considerations

Deciding what to signal to consumers is influenced in the first instance by legal obligations around information provision, for example, those found in marketing standards and mandatory labelling regulations. Signals around nutrition and dietary related advice are an example of this (see figures 2 and 3).

Discussions with stakeholders reveal the challenge and importance of signalling information to consumers. Beyond mandatory-based signals, a key challenge is possessing knowledge on what consumers would like to know about their food purchases. One approach used to find out what consumers’ are interested in knowing mentioned by stakeholders was the use of focus groups of consumers. A comment by one stakeholder (#2), a global manufacturer, illustrates the diversity of consumer interests and what they may wish to know about their food and food purchase. They said:

People have lots of different interests and motivations and while some may be interested in nutritional value of the food and their family’s health, other people are motivated by animal welfare or fair trade issues. So people do have different interests and at different points in time as well.

Many of the stakeholders commented on the short time in which consumers have to make decisions about their food and food purchases. Consumers are generally regarded to have an interest and concern with purchasing food that meets their requirements and needs but can only afford a limited amount of time choosing and purchasing food products.
A further challenge is the sheer volume of information concerning food that is potentially available. Tracking and tracing systems have contributed to the increase in information. A tension exists regarding a) how much consumers wish to know b) the time they have to receive the information at the point of purchase c) the space available in which to communicate information on or near the food products.

Therefore signals, in order to be effective, need to representative of a broader message or need to be linked to system of signalling, of which consumer recognition must be relatively high. One method, the use of certification schemes, is discussed in greater depth in section 2.2.

More broadly stakeholders, in particularly, retailers and manufacturers, are required to develop an approach to signalling to consumers about their food which provides a balance between supporting consumers’ right to know and what consumers wish to know and are specifically interested in. The importance of communication in enabling consumer confidence was emphasised by stakeholder (#2), a global manufacturer. For this company, a number of principles guide communication with consumers including ‘support for consumers’ right to know’ about the products they purchase.

**2.2 Certification schemes: key strengths**

This section draws upon stakeholder perceptions of the strengths and effectiveness of certification schemes in communicating information to businesses and consumers. The effectiveness of certification schemes transcend beyond signalling to consumers however as reflections by stakeholders reveal how such schemes and their associated standards play an important role in meeting the goals of NGOs, retailers and manufacturers.

**2.2.1 Certification schemes and signals: Business-to-Business and Business-to-Consumer**

Certification schemes are effective in their business-to-business communication as much as business-to-consumer communication. The processes which underpin certification schemes, for example auditing, results in confidence that compliance is reached on particular standards (stakeholder #1)\(^{19}\).

The effectiveness of the certification schemes goes beyond signals to consumers. As this stakeholder pointed out, business-to-business signals and trust are critical too.

19 Lack of adherence to regulations rules on farming practice rules has contributed to some severe problems for farming and at time, even crisis. Two stakeholders cited crisis in farming during the 1990s as a significant driving force in the creation of their schemes (one based in Germany and one in the UK).

Two examples of this were identified by the UK based stakeholder (#1), the first concerns BSE; ‘the BSE outbreak had a huge impact on the British farming industry as farmers were unable to export beef. Facing this, retailers began to import from abroad’. Secondly, more recently, the UK’s foot and mouth outbreak ‘devastated’ the farming industry ‘so the scheme and its associated rules, inspection and audit process is as much about governing farm practices and using those processes to safeguard the reputation of the industry’.
‘So our primary purpose is that business to business communication so we inspect a farm against a set of agreed standards primarily so that the next guy in the chain can have some information about their suppliers and we communicate that by way of certification. So the supplier has to demonstrate that they have passed the test’

Certification Scheme Owner (S#1)

With regards to the effectiveness of certification schemes in signalling information to consumers, the certification scheme owner quoted above summed up consumer-facing signalling as ‘making a virtue out of a necessity’. In a comparable way, another scheme, also saw the development of its standards and organisation predate the development of the consumer facing logo. The Marine Stewardship Council’s logo, used to signal information about the work of the Marine Stewardships Council, was, according to one interviewee an outcome of the necessity to connect consumers with efforts being made to source fish sustainably.

Thus the systems that generate information (for example, certification-standard systems) and exist to fulfil business-to-business signal obligations may be a foundation upon which a logo can be launched. The creation of a logo in this way demonstrate compliance to the consumer and is a further way of utilising or using information along the supply chain or around a particular food production or process practice (beyond business to business signals).

A recent report published in the UK by Which? –‘Making Sustainable Food Choices Easier’ detailed the low levels of consumer recognition of logos existing in the UK market\(^{20}\). According to the report however, consumers expressed their interest in receiving clearer messages via labels on social, ethical and environmental issues. Interestingly, the report focused on logo recognition rather than understanding the fuller meaning represented by the logo. Consequently, the effectiveness of logos rests with their ability to be recognised rather than communicate significant amounts of information per se. Logos thus represent a tool of communication but recognition rather than understanding is a key function. On the topic of the effectiveness of logos in signalling information to consumers, stakeholder #1 made the following point. In their opinion, of significant importance is how consumers act, rather than what they recognise and understand from the logo. They said:

‘What we don’t do is give people an exam and not allow them to buy the product unless they pass the exam. So what matters to us is recognition and influence and if they are influenced by the label for the wrong reasons but they are still positively by then we don’t care very much because they are still acting in the way we want them to act.’

In addition, the logo was considered an effective indicator of retailers’ support (through stocking of certified products) of UK farmers. A certification scheme owner (S#1) explained:

‘For example because our logo is only on British products it exposes fairly clearly what British offer they [retailers’] have, for example on the chicken or poultry counter. So consumers can see at a glance, where there is British product...To some of our constituents that is quite important to have that transparency and it is probably not the retailers who are getting the benefit of that, but it is probably the producers.’

Consumer recognition of logos was emphasised by other stakeholders as important in the success of signalling certain messages to consumers. This stakeholder, a UK major own brand food retailer (S#8), explained the importance in choosing a certification scheme that not only matches the agenda of a retailer (for example, of fair trade, sustainable sourcing etc) but also one which has some weight in the market and has ‘the most credibility and resonance with the consumer’. This involves selecting one of the ‘five or six labels out there that have the ability to transcend the noise and get through to consumer’.

\[2.2.2 \textbf{The Utility of Certification schemes: meeting the goals of stakeholders.}\]

Logos can both signal information about the product and provide assurance about the food product. For example, carbon footprint labelling aims to inform consumers about the amount of carbon dioxide and other greenhouse gases which have been emitted as part of a food’s production, process and distribution and disposal. A figure of calculated results is provided in kilograms\(^2\). Logos which provide assurance about food may do so on a set of selected standards, often these are usually centred around quality, food safety and indicate that a set of standards have been met in the course of the production, process, storage, packing and transportation\(^2\).

A range of stakeholders expressed the role of independent and third party schemes as significant in signalling messages and information to consumers. Signals generated from independent certification schemes are considered by stakeholders to be based on verifiable and credible information. This is because, as one stakeholder explained, the standards and related system of audit enables ‘confidence that producers within our system are complying with the standard’.

Stakeholders discussed the diversity of 3rd party certification schemes. Diversity, in this context, refers to the range of certification available, each representing different food related issues. Currently, there is not one single third party scheme that represents all the signals identified in this book (refer to table 1). Consequently, stakeholders, such as retailers and manufacturers, seeking to certify particular products have to prioritise signals they wish to communicate to consumers and choose a scheme which best fits their supply chain requirements and goals. A global manufacturer (S#2) explained the rationale behind using third party certification schemes.

\(^{21}\) These include: MSC, FSC, Fairtrade, Rainforest Alliance and Soil Association.

\(^{22}\) The Carbon Trust is responsible for a carbon footprint-labelling scheme in the UK.

\(^{23}\) An illustrative example of an assurance scheme logo is the one used by Assured Food Standards (see appendix 1 for an image of the logo).
In order to communicate that we are meeting the highest standards to consumers, consumers need to have some credible, independent, third party communication of that. There is not one single scheme, which covers animal welfare, environmental sustainable, social and labour standards and so on. So we look at commodities on a case-by-case basis and we look at who is the best partner to work with. And some cases it is not clear-cut and there is more than one to work with. But one thing is for sure, whether it is sugar, palm oil, tea, or ice cream ingredients, the partners that we use are members of ISEAL- the very highest standards.

Membership of ISEAL Alliance by certification scheme owners therefore sends a message to retailers and manufacturers seeking to certify their food products. The International Social and Environmental Accreditation and Labelling Alliance (ISEAL Alliance) is an organisation that describes itself as a global association for social and environmental standards. ISEAL works by advising certification schemes on standard systems and conferring independent approval on the standards used to underpin certification schemes by its members (for example, Rainforest Alliance and MSC). This contributes to the credibility of the standards of certification schemes. The ISEAL Alliance operates by working with its member organisations to develop credible standards.

ISEAL develops codes of good practice that are implemented by the member organisations, for example, the Code Of Good Practice For Setting Social and Environmental Standards. In 2010 the ISEAL Alliance began to develop a Code of Good Practice for Assessing the Impacts of Systems (Impacts Code) and has also expressed its intent to develop a Verification Code of Good Practice in the near future. This indicates that greater attention towards capturing information relating to impacts of standards will be made in the future. As yet, however, ISEAL Alliance does not have a code of good practice, which covers the extent of the claims that may be made from following a set of standards. Similarly ISEAL Alliance does not provide guidance on the subsequent labelling and use of logos.

Some retailer and manufacturer stakeholders spoke of the effectiveness of 3rd party scheme certification schemes in enabling them to meet their company goals concerning sustainability. Thus such schemes are part of a broader strategy adopted by companies to in meeting commitments around sustainability and corporate social responsibility agenda (for example, with the implementation of fairtrade standards on specific commodity lines).

A global manufacturer stakeholder suggested that their policy of using 3rd party certification schemes complements existing government policy on the potential of certification schemes as a tool to implement higher sustainable and development related standards:

‘I like the Department for International Development (UK) position on this, which they explained as part of 20 year food vision earlier in year which was just to try and encourage business companies to meet highest possible standards and to come to market with products that meet those standards whether it be Rainforest Alliance or Fairtrade to try and make it as mainstream as possible’
Organisations, which operate certification schemes, are considered to have the expertise on particular aspects of social, ethical and environmental aspects of supply chains. A stakeholder retailer expressed this:

We rely quite heavily on 3rd party accredited we are the world’s largest fairtrade retailer by value you know we see the value in being able to rely on 3rd party to accredit elements of the sustainability agenda because we are not, we put our hands up and admit we are not the experts and that as a retailer we are not in control of whole or parts of the supply chain and we need to look to accreditors to give us the assurance around some of the issues that we feel are important.

The benefits of using standards contained within schemes are not just realised by retailers and manufacturers. For some stakeholders such as non-governmental organisations, certification and the standards associated with certification represented a method in which to promote a particular system of farming, for example, sustainable farming methods. Certification is used a way of ‘driving our mission’ of helping farmers to practise sustainable methods of farming. A non-governmental organisation representative explained (S#5):

So really the logo means that the product comes from certified farms and we use certification as a way of driving our mission and it something that companies have very much embraced because it becomes, for a company, it becomes a 3rd party accreditation of what they actually doing and they may have been doing the right thing for many years but this helps how to talk about what we are doing on the ground and how to get the validation or endorsement of a third party.

For another NGO stakeholder (S#10) linked with a certification scheme, the logo and label aspect of their activities was considered to an effective tool in changing conditions for producers in developing countries. They said:

If you just see yourself as being a label then you are probably quite limited and I think we never set out just to label products, we always saw labelling as one tool of our kind of wider work of raising awareness and debating fair trade and as at the same time see what we can do practically to get trade working a little bit better for producer communities in the global south

Most importantly however, and as the previous stakeholder quote suggests, logos and labels are rarely created until an organisation has agreed on the standards and aims underpinning it. Thus, the
origins of organisations that subsequently develop certification schemes and logos are an important consideration in understanding what they seek to signal.

2.2.3 Reactive transparency: communicating beyond the logo

The required levels of reassurance from actors within the food supply chain alter, and are dependent on how food issues are discussed and represented in broader society. A quote from this stakeholder (S#1), an assurance scheme owner, illustrates that at times, the appearance of critical influences, such as probing about particular farming processes and practices from NGOs and CSOs necessitates communication to consumers that goes beyond the logo and draws directly on standards.

‘Because although we have some facility to communicate to consumers to make them feel comfortable and warm about current standards, there are other influences who are saying that this is not good enough, that is not good enough. And that feeds back to us and we have to shift our standards forward and feed our communication and say we have responded to that’

The creation of and subsequent compliance of standards enables some stakeholders to adopt a defensive position, in particular, where situations of ‘crisis’ transparency occur. Such situations occur when particular practices or claims are challenged. Consequently a system of standards protects and ensures credibility with the highlighting or citing of particular standards. For example one stakeholder (S#1) said that in response to discussions regarding pesticide use in farming, they are able to respond to public debate by ‘saying that fruit and vegetables coming from our system are safe to eat because of X and X standard. And there is laboratory testing done routinely to demonstrate this outcome.’ Consequently standards themselves are used to add to credibility of the information shared in communication and signal information beyond the logo itself.

Situations change however, and the level of transparency can move from signals linked to assurance to communication which has a greater depth of information and is more precise. Stakeholder #1 illustrated this by referring to their experience of a national newspaper reporting on meat production and halal.

This is what we are trying to do except if daily newspaper runs something tomorrow, for example, on halal, which they did a couple of weeks ago, and misinforms the hell out of people then we start to get detailed questions. The level of detail and the level of questions that people are suddenly starting to ask about our system changes over night and shifts a gear and we have then to be in a position to provide very specific answers to very specific questions.
Certification schemes and the methods that underpin them prove to be an effective way to respond to information challenges because 'We believe that within that technical scope that we have that we have got to answer any question that bears on that,' (stakeholder #1).

Consequently, the scheme becomes ‘a communication tool of the industry’. A recent example of the certification schemes’ role in communicating on behalf of the industry was the news regarding salmonella presence in Spanish eggs. The scheme owner was able to use the standards within the scheme:

'It [set of standards] enabled us to say this does not happen here because we have this, this and this control why would you want to buy your eggs from Spain when you can buy our eggs.'

Stakeholder #1

2.2.4 Stakeholder cooperation and signals

In order to effectively signal information to consumers, stakeholder accounts reveal the importance of cooperation and alignment in sending of signals to consumers. Strategies of alignment, in which a common approach is developed around the signalling of specific types of information aims to prevent lessen confusion experienced by some consumers. Consensus and collaboration feature as an approach to signalling messages to consumers. Stakeholder #2 expressed how they ‘work closely with supermarkets to ensure we are aligned in terms of providing additional information to consumers’ because ‘there is a big push to make sure there is some consistency of messages around particular times and around particular themes’. Examples of this include Fairtrade Fortnight and the Food for Life public health campaign.

Certification schemes were cited as opportunities, which created partnerships and cooperation in signalling to consumers as suggested by this assurance scheme owner stakeholder:

We believe get a bit of reassurance from our logo and a lot of reassurance from the Tesco brand or retailer brand and if you put them together they are synergistic.

Stakeholder #1

Stakeholder#10 explained the importance of ensuring that certification schemes and their representative logos do not to displace the products’ own brand. One example of this is located in

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24 Fairtrade Fortnight is a campaign event that runs annually in the UK. Primarily, Fairtrade Fortnight aims to increase awareness of fairtrade and celebrate fair and ethical trading. The Food for Life public health campaign is based on a network of schools, communities and food charities seeking to change food culture in the UK.
fairtrade in which product coverage has significantly increased in recent years. In order for a logo to become mainstream, according to one retailer stakeholder (S#9), it is important to ensure that the logo is ‘not the brand of the product’. Stakeholder#9 explained this further, using fair trade products as an example. They said:

I don’t think there is a single brand in the UK market where the fair trade mark overwhelms the brand of the product and I think that is very important in terms of mainstreaming because if we want there to be 4000 products then they can’t differentiate purely on the basis of fair trade anymore. If there are 800 brands fair trade coffee out there, each brand has to stand for something and not just fair trade because they can’t live or die on being fair trade.

Moreover, the widespread adoption of an independent certification scheme which focuses on a specific signal forces retailers and manufactures to look for new ways to differentiate themselves, their brand and their food products. One way in which retailers and manufacturers might achieve this differentiation is a focus on the quality or price of a product. Another, as described by this retailer stakeholder, is the extent of which a practice is adopted, for example, fair trade.

It actually helps if Sainsbury’s and Tesco’s carries the fair trade label too because it gives the consumers a reference point, we just want to say that we do better so all our coffee and tea is fair trade and that other supermarket might be 10%, so because it is fair trade you have a reference point between their 10% and your 100%.

Reflections of certification schemes by stakeholders reveal how certification schemes offer a range of benefits, including as a tool to signal information to consumers and to businesses. Independent 3rd party schemes were rated highly as a tool in which to verify processes and practices and thus strengthen signal quality. Moreover, such schemes were highlighted as playing an important role in meeting the goals of NGOs, retailers and manufacturers. Cooperation between scheme owners and retailers and manufacturers with the alignment of messages sent to consumers was a further practice identified by stakeholders.

2.3 Weaknesses and challenges

This section reports stakeholders’ perception of the challenges of signalling information to consumers and the weaknesses of certification schemes in addressing these challenges. Focus is placed on the complexity surrounding consumers’ understanding of food and the limited range of commodities certified by some certification schemes. In addition, the use of own brand omni-labels and, retailer and manufacturer-led standards are discussed. Finally, issues raised by specific signals are explored from a stakeholder perspective.
The effectiveness of logos and certification schemes is dependent on a particular commodity and consumers’ understanding of it. For example a global manufactures (S#2) said that with some commodities ‘it is blindingly obvious to consumers what they are, so for example, tea. It is just dried tea leaves’. Whereas with palm oil for example, it is unclear because it has multiple functions and its presence may not be clear for consumers, for example it is ‘used as fuel in cars, tiny quantities in shampoo, [and in] margarine so it does not melt in boot of peoples’ cars’. Consequently, this influences how the stakeholder communicates to consumers about palm oil:

Because we use in it in so many products, we have taken the view that we should talk about it from a corporate perspective.

A piecemeal approach to certification and commodities is inevitable, in particular where certification is linked to improving the sustainability of farming practices or implementing policies fair trade. A certification scheme owner (S#5) suggested that for certification scheme owners the prospect of having only one certified ingredient in a multi-ingredient product, such as a chocolate bar, might create opportunities for change in the practices surrounding other commodities. She said:

At the same time we are communicating with the consumer that it is the cocoa in that chocolate bar that is certified and we would rather really have someone have that with cocoa and be really working hard on the other commodities, and have some firm commitment on cocoa because the impact of that is enormous and you can’t wait for everything at the same time, as long as they have a plan, as long as they are working on something or with other schemes then we will be happy having our seal on that pack.

A single based logo, signalling one key message is considered effective if it is well recognised and distinct. However, this creates a further challenge in that consumers’ expectation of may not be met by one singular certification scheme. This was the experience of a stakeholder (S#10) who represented a global certification scheme.

‘I think the other thing is that all of these labels offer very distinct propositions and I think the other challenge is that people expect these labels to deliver miracles, so you kind of say you know, you get all sorts of feedback, like why doesn’t the label guarantee the quality of the product or why can’t we do something about the amount of packaging that fruit comes in, but you kind of say, well you know, these are not the decisions for us to make but for retailers and manufacturers know best how to manage their product, but of course we hope that our label will be part of a suite of interventions that a company is making. But we don’t kind ourselves for a minute that we are the magic bullet to every problem that afflicts global supply chains’.

One potential remedy to this is the implementation of an omni-label scheme. An omni label seeks to provide consistent information on more than one information area. One working example can be
drawn from the global retailer Royal Ahold. For own brand products, Royal Ahold, have developed a type of own brand omni-label scheme which covers 5 main areas: biologisch, fairtrade, duurzame vagst, scharrelvlees and ecologisch\textsuperscript{25}.

So far, however, the development and implementation of omni-labels have lacked the credibility held by single-issue independent labels. Moreover, as one stakeholder suggested, the development of omni-labels does not account for the trade-offs that occur during food production. Arguably they do however provide consumers an overall picture on a range of issues linked to their product. Ultimately however consumers will have to make the choice and any necessary ‘trade off’ themselves.

While logos that represent certification schemes are mostly considered effective, the standards which certification schemes rely upon are, for some, recognised as an increasing burden for producers. This is because some producers are certified across a range of different schemes. One stakeholder, who represented a social and ethical certification scheme, said that greater collaboration between schemes was required to reduce the burden. Moreover, the stakeholder gave one example of how they were developing a method of collecting information about carbon impacts alongside their existing information requirements. They said:

> So at that level, there needs to be a good collaboration. So we are looking to see if we can offer producers a carbon assessment alongside their audit because producers are being asked if they have done one, and if they have that data available but also and more importantly from our perspective is, if producers are going to need to adapt to climate change. A carbon assessment might be a useful tool for them in looking where they might be adapting.

Finally, one stakeholder with a background in retail raised a practical issue relating to the design of packaging. According to them, the processes of pack design and redesign may take a substantial amount of time and affect the implementation a system of signalling. Moreover, ‘there is a tension to add things to packaging and then every now and then a big cycle of clearing things off and making it clearer, simpler and easier for consumers to read the packs etc.’

2.3.1 Key challenges around specific signals

The challenge around signalling successfully to consumers may be dependent on the type of information and signal that retailers and manufactures seek to communicate to consumers. In the rest of this section we discuss specific signals and the ease or problem encountered by stakeholders in transmitting them to consumers. Not all of the areas covered in the project were raised by the stakeholders, for example, few stakeholders discussed the challenges regarding signalling information around nutrition and dietary related health.

\textsuperscript{25} The terms in Dutch broadly mean the following: pure and honest, fairtrade, sustainably caught (referring to fish), animal welfare, and organic. The first and last two terms ‘pure and honest’ and ‘organic’ are sometimes in the Dutch language interchangeable.
2.3.2 Food safety

A key difficulty with signalling food safety is, according to an assurance scheme owner (S#1), the absence of competitiveness between food providers. This is, in their opinion, a result of the position taken by DG Sanco. The stakeholder summed up the DG Sanco position as one in which ‘no one should be competing on food safety because all foods are safe’. Consequently, a certification scheme that seeks to assure about standards and safety represents a ‘platform’, which is ‘precompetitive’, and one that ‘everybody needs to be on otherwise people lose confidence in the industry’.

2.3.3 Origin and provenance: responding to policy anomaly?

Different rules regarding labelling of origin for different meat products has created a policy anomaly on origin labelling. Consequently, certification schemes have some influence and have the potential in being an effective mechanism to overcoming the legislative ‘gaps’. One stakeholder explained how this was overcome by changing the standards in the certification scheme. They said:

The primary producer is not happy with that [rules on origin labelling] because I mean, take the example that everyone uses, it means that if you bring pork in from Poland, and the produce bacon in a factory in Norfolk it is labelled British bacon because it is produced in a factory in Norfolk and there is a school of thought that is misleading to consumers and if you call something British bacon then the expectation will be that the pigs came from Britain. So we have established our own rules on that and if our label has a union flag in it, it was farmed in Britain and it was processed. So we have been very clear on that for ten years and will continue to cut through the fog with that until we are made redundant on that point because someone clarifies the legislation. But we are not holding our breath.

Recently, the British Retail Consortium and meat retailers and manufacturers have made moves towards greater consistency in the area of origin labelling with a voluntary agreement. Supported by the UK’s Department of Environment, Food and Rural Affairs (Defra), a voluntary code that sets out the principles of origin labelling for processed meats have been agreed.

2.3.4 Environment and sustainability

Key challenges around signals relating to environment and sustainability include: the complexity surrounding the issues, lack of agreed methodologies which inform standards and certification and the range of sub-issues which come under the umbrella of this broad signal. Examples of the types of information that may be categorised under environment and sustainability relate to the following: biodiversity and farmland management, carbon footprint labelling, organic production and sustainable sourcing practices. The numerous issues and the complexity create challenges for stakeholders who are implementing environmental and sustainability related standards and practices in their food supply chains. One UK retailer stakeholder expressed this:

I think that is the challenge that we have the tension between, we are doing all this stuff, and we want to tell consumers but they are not ready to know about it because some of the issues are so complex, so how do you get across the complexity of palm oil, fish stocks and so on, how do you get across the complexity of some of those things?

Stakeholders emphasised the importance of taking account of the unevenness of progress and development of sustainable food chains in signalling information to consumers. For one in particular, a UK retailer, third party certification schemes are vital in offering an understandable method in which to communicate to consumers. In the example quoted below, the retailer-stakeholder perceives established independent 3rd party certification schemes as a useful and effective tool of communication. For them, such schemes are easily utilised for communication purposes compared to their own systems of standards relating to sustainability.

We have our own internal processes to move species and fisheries from a red rating which is a poor rating to a green rating which is a good rating, but obviously we can’t communicate that customers so easily as we would require it would explain what it meant and there it would open us up more to scrutiny which is why there is not that third party element to it which is why we look at MSc to underpin or support our own principles.

The strategy of choosing when to communicate effective sustainable food chain practices reflects the complexity of both practices and signalling in this area. This gives rise to a piecemeal approach in which sustainable practices are gradually implemented over time and commodity type. According to one certification scheme owner stakeholder however, third party certification schemes have a role in leading the moves by retailers, producers and manufacturers towards sustainable food. For them, making commitments on one commodity, such as cocoa, will create need to ‘have to look at what else is going on in your supply chain’. Thus, ‘sustainability is a journey, [it is] not a destination’.

**2.3.5 Animal welfare**

Signals about animal welfare can be transmitted via mandatory labelling as well as through logos underpinned by certification schemes. Signals linked to animal welfare seek to provide assurance about the welfare of animals at all relevant stages: farming, transport and slaughter. Signalling is important because consumers are unable to verify at the point of sale that animal welfare protection has been maintained in the process and production of food.
Mandatory legislation exists in this area; for example, legislation on egg marketing governs how EU egg producers are required to label eggs sold to consumers. The labelling of eggs signals to consumers the type of production system used by producers. The labelling scheme is thus based on the presumed welfare outcomes of each production method.

One stakeholder claimed that while mandatory regulation on the labelling of the farming method used in the production of eggs has been ‘immensely helpful’ in allowing consumers to make choices on an informed basis, there were still considerable rooms for improvement to make the legislation more effective. For example, animal welfare was also cited as one example of where transparency has played a role in transforming specific commodity and food markets. This stakeholder (S#4) representing a NGO uses the example of labelling on egg packs to show how free-range eggs have moved from a niche market to the mainstream.

‘There has clearly been an increase since the labelling of egg packs came back in 2004. In many parts of Europe, particular in eight or nine of the northern countries, there has been huge increase, and in the UK by now, half the value at retail value is of non-caged eggs. It has gone quickly from being a niche market to having a big market share and I am absolutely clear that transparency is a part of that.

Mandatory labelling, in the opinion of the NGO stakeholder (S#4) has proved successful, but nonetheless a cautious view is required. In particular, the stakeholder suggested that the main message communicated about farming systems on egg packs were potentially diluted and less effective when set alongside marketing messages and imagery. They said:

If indeed, anything, one is getting, whatever the opposite of transparency is, and one is getting elements of dishonesty. I mean just to give one example, not here but in other European countries we are finding that egg packs that might have the right wording on but also have a picture on the pack of battery eggs of free range eggs. Even if not the hens, even if a rural traditional outdoor scene, what you are communicating to consumers is that these are outdoor eggs not battery.

This represents a form of counter transparency and questions assumptions of the effectiveness of mandatory labelling enacted in regulations in signalling to consumers.

Key to what is perceived as having made a difference is the identification of factory or battery farming style farming (in the production of eggs) on the eggs packs. Identification of such forms of farming often remain absent in the current labelling system of meat and dairy, instead only

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perceived better systems are indicated via logos and labels and certification schemes. The NGO stakeholder(s#4) proposed that ‘the mechanisms of logo and labelling to indicate farming systems linked to animal welfare should be extended from egg production to dairy and meat products such as pig meat. In particular, this would involve revealing to the consumer ‘how that animal has lived, how it was reared’.

The practice of food safety was felt to conflict with some of the standards linked to animal welfare. For example, this stakeholder(s#1) representing a certification scheme which promotes products that have met a range of product assurance standards discusses how some threats, such as avian bird flu can contradict farming practices linked to higher animal welfare standards because the poultry are required to be kept indoors during an outbreak. Giving more detail, the stakeholder explained:

’It is not just a single issue; the issue that we deal with food safety and animal welfare can sometimes be in conflict. The biggest pressure on us is to improve food safety from government is to improve food safety standards in chickens.... Yet the lobby group pressure and they don’t even understand the food safety issue. And there are two conflicts because what we are being asked by the food standards agency to lock the doors, don’t let anyone in, don’t let any rats, vermin, mice, birds, flies, - ultimate bio security. And you can’t get that with free range’.

3 Stakeholders and signals and management

This chapter has outlined a range of perspectives from stakeholders, which reveal the strengths and weaknesses of using certification schemes and their associated logos to signal information to consumers. Retailer and manufacturer stakeholders, in particular, discussed the challenge they face in signalling to consumers. This consisted primarily of responding to the complexity of some signals, for example, around sustainability and the environmental impacts of foods and having to maintain a balance in the provision of information. This balance has to ensure that enough information is available to consumers yet not overload consumers with too many signals and information. This section of the book focuses on the management of signals and information discussed by stakeholders to overcome these challenges.

3.1 Information-editing

Responding to the challenges (identified above) requires different degrees of ‘information’ editing. Information editing in this context refers to the use, presentation and accessibility of information and how stakeholders edit that information.

In particular, one stakeholder reflected on how standards organisations, such as certification scheme owners potentially have a significant role to play in information editing. Moreover, information editing is necessary in order to make the information accessible and the signal robust. This stakeholder discusses this in the context of information relating to sustainability.
Another aspect of it is choice editing and there is still a role for stakeholders in this because the information without choice editing, or categorisation or taxonomies of sustainability which categorise and organise the data would make it useless in a lot of cases and for most people’s purposes. So there is a strong role for standards organisation and their stakeholder networks to shape and present the data and give it a stamp to make it meaningful and worth communicating.

Stakeholder #3

Information editing need not relate only to the consumer. For example, for some farmers who meet the standards set by the certification scheme, there is a desire to see greater communication with consumers about their farming practices. In this way, the scheme becomes a mediator, having to select which information is appropriate for consumers. Often this is decided on consumers’ perceived level of interest in receiving and knowing that information. Two stakeholders who are each involved with certification schemes particularly emphasised this point. Stakeholder #1 representing a certification scheme said:

‘So this is one problem we have on doing this job effectively on behalf of farmers because farmers are really close to what they have to do to meet our standards to meet the standards of the retailers and therefore cannot understand why we are not putting out really detailed information about the welfare of chicken, or info on pesticides. And the reason we don’t do that is that consumers are just not interested, and we know that because we sit down and do focus groups with them, 99% per cent they are interested in some level of reassurance that someone is looking after stuff on their behalf and they can feed it to their children’.

In order to be effective, signals sent to consumers via the food products they purchase, according to one retailer stakeholder, have to be part of the ‘story’ of that product and therefore be relevant.

Information editing is required because, according to retailers, too much information to consumers can be a burden. An approach to negate the tension between too much and too little information and ensure signals are effective, according to one retailer stakeholder, have to be part of the ‘story’ of that product. A ‘story’ comprises of a chosen number of information areas chosen by the retailer, brought together in a coherent way and one that is perceived to be relevant.

You pick three things, you are going to tell people about the health issues with it, because threat is legal you have to tell them that about salts, fats and sugars and frankly I put that in my body so I really want to know that information, second, you are going to tell people about the packaging because you are going to be left with the packaging problem, and you might tell me all about the Amazon, but I am stuck here with the packaging and I need to know what to do, and then the third tertiary level is that you might be left with space to tell about where the product came from, the sourcing story, so I have got a ready meal, I could
tell you about the spuds and the fish, but I will probably tell you about the fish story or free range eggs in a quiche. So we will pick the most relevant story but not all of it.

Stakeholder #8

In part, the pressure to provide all aspects of information around a particular food product can be lessened by choice editing. Choice editing refers to “pre-selecting the particular range of products and services available to consumers”28. For example, if a retailer implements a policy of only selling free range eggs and commits to using only free range eggs in all of their products, (including read-meals etc) there is less pressure to explicitly signal this information to the consumers directly on the product. Similarly, if a retailer stocks only fair trade tea or coffee or bananas, there is less pressure to emphasise this directly on the product itself. One major retailer explained how choice editing, as part of a brand promise, might lead to requirement for less rather than more information signalled to consumers via a specific product.

Information – editing, so what we say is that people cannot respond to it all. And that takes you onto this next point which is choice editing, you can only buy fairtrade tea and coffee from us and we only use free range eggs so in a way you don’t need a label on the product because our brand promise is that all our eggs are free range

Grocery Retailer - Stakeholder #8

When we went 100% fairtrade on bananas, we knew what it meant but probably a handful of customers knew what it meant but the point is that all of our customer are buying fairtrade, whether they know it or not, whether they care or not. So its delivering sustainability by stealth and the fair trade logo happens to be a part of that journey to sustainability.

Retailer-Stakeholder #9

3.2 ‘Guardian’ and ‘Gatekeeper’

A further key challenge is the limited space afforded on food packs and labelling itself. This has resulted in the development of two approaches to signalling information to consumers which can be summed up as ‘guardian’ and ‘gatekeeper’ approaches. Each of these approaches help retailers and manufacturers to overcome the limitations of on-pack labelling in signalling information to consumers. A guardian approach is one adopted by retailers who seek to provide ‘reassurance’ or ‘assurance’ to consumers by assuming a position in which they suggest to consumers – ‘Let us manage the complexity and you trust’. One stakeholder, a organisation focusing on standard systems

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in certification schemes, referred to a leading own brand UK food retailer an example of a retailer possessing this approach. The stakeholder suggested that:

‘The ‘Name of Company ‘approach is to tell consumers that ‘they are doing all they can but don’t worry about because if you shop here you are doing the right thing’.

Stakeholder #3

Such an approach is partly linked to understanding the level of information consumers wish to know. For example, stakeholder #1, a global manufacturer made a similar point:

‘Yes so we know that our day-to-day communication is a bit of a pat on the head: ‘do not worry, everything is fine’’

In the absence of certification schemes for a specific commodity or one that is from a particular geographical location, retailers and manufacturers may develop their own standards. These may or may not be communicated to the consumer. Examples of this include the Good Agricultural Practice Guidelines29 programme recently launched by Unilever which built on their commitment to the Sustainable Agriculture Programme30. While not available on the product, information about the programme is available on the stakeholders’ website. ‘Plan A’, developed by Marks and Spencer’s reflects a similar approach in which a whole organisation reviews its activities and commitments to supply chain operations and seeks to communicate the results on a regular basis31. There is a move by such companies to build into their whole corporate brand strategy types of supply chain controls that suggest to the public that the company is doing the right thing. That is, the company is automatically identified as being responsible about its food supply. In the case of “Plan A” this goes to the heart of the procurement principles of the company along all of its supply chain.

A ‘gatekeeper’ approach is one in which the provision is made of opportunities for consumers to find out information at a post-purchase stage. Thus, the product and the contact information stated on the product represents a starting point and gateway from which consumers can access more detailed information about aspects of the product. This is partly because, according to Stakeholder #2, of the need to ‘be realistic to target consumers and just give them opportunities, once they have made their purchase decision to get more information.’ Part of the motivation to provide consumers with post-purchase opportunities to find information was linked to the perception and understanding that ‘buying decisions on supermarkets is relatively quick and short’. Such an approach enables stakeholders such as retailers and manufacturers to overcome the limitations of space constraints of labelling.

accessed 13/12/2010


31 http://plana.marksandspencer.com/about/the-plan accessed 13/12/2010
4 Best practice alternatives

This section highlights areas of best practice alternatives that are not label-based.

4.1 Non-label information provision

Certification schemes and their logos represent one method of communicating to consumers. For example, stakeholder #2 explained that certification schemes are part of a wider repertoire of communication tools – some of which are not based on the label.

‘Consumers spend relatively small amount of time looking at the product in the store and we have a lot of information to get a lot of our packs, ingredients and marketing information too. So those packs can be quite crowded. So I think it’s about being very careful about our communication and being very clear but also that consumers do have the ability to find our more’.

Stakeholder #2 highlighted the role of non-label methods of information provision to consumers.

‘We have our website, we have our phone lines, which people can phone and get a whole range of information, for example if they are interested in an issue or any particular aspect of the product. Our care line has a resident nutritionist on hand and our nutritionist helps to train our care line advisors.’

In addition, it is possible to ‘get specific advice on allergy and if you are not sure if it is in a product’. For stakeholder #2 the provision of care lines and on the pack phone numbers made information accessible to people. This was revealed further by ‘½ million calls on care line in UK, of which complaints were 30% and advice 70%’. This, according to the stakeholder provided the consumer with a ‘useful way to get specific information about products’ and offered an opportunity for the company to receive views and feedback on products from consumers. Information provision at the point of sale, in store and on leaflets was also emphasised by retail stakeholders.

An NGO stakeholder who operates a sustainable farming certification scheme said a key challenge for them was communicating effectively on a relatively small budget. For this NGO, funds allocated for advertising and marketing of the certification scheme and logo were limited. This emphasises the importance of a) engaging with CSOs and b) cooperation with retailers and manufacturers to promote the NGO and raise awareness of the food available branded with their logo.

4.2 Future of transparency, signals and certification schemes

Many of the stakeholders commented on the potential role that technology in transmitting signals to consumers. Technology, in the form of handheld barcode readers and web-based phone applications,
were held by stakeholders as a potential solution to the limitation afforded of space found in existing labelling practices

If a consumer wants to know more, in the aisle of the supermarket, using smartphones, or pulling back a label the consumer should be able to learn more. The vision I have that should be fairly free information and you could reach back and see the people who have picked the oranges you have bought. Produce traceability initiative should be possible to see from to the crate level of product.

As the quote above indicates, traceability becomes an essential part of transparency and signalling when it is facilitated by technology. Such methods of signalling messages and information to consumers have begun to emerge. For example, a certification scheme known as Linking Environment and Farming (LEAF) have implemented ‘LEAF Tracks’ – a programme designed to allow consumers to locate more information about their LEAF certified food. Users are advised to input the product number into a dedicated website which hosts the database of LEAF members. Interestingly, the scope of information revealed is largely decided by the producer who is permitted to edit the information available. Thus, users may locate a minimal amount of information, such as location of production and the type of farm or, in other cases, may access more biographic information about the farmer and other activities undertaken on the farm. This form of information is however only available once the product has been purchased by the consumer. For the stakeholder (S#6) below however, the use of technology to provide post-purchase information is not necessarily a problem. They said:

Yes, I think a lot of the views are that you put a link on the packaging or the promotional material and ask people to look online, because if you are going to look online you are going to make time to sit down and read it and you can offer more information, a bit more detail and you can offer links to accreditation services or partnerships that you are working with. So I think yes, that is something that is very useful, so whether it is through a laptop or pc at home or an app. This will be the way forward.

Technology may utilise information developed for the purposes of traceability and in doing so provide greater transparency for consumers about their food purchases. Technology-led initiatives in this area potentially can overcome the limitation of space as information about products will no longer be stored on the product itself but accessed using a code via a website or handheld device. Key problems remain however. Firstly, consumers still require an effective basis on which to compare products and secondly, consumers make purchasing decisions in considerably short amounts of time. Thus, while the potential of technology is recognised, it is not with confidence that one can assume that consumers will be able to digest and respond the greater amounts of information that such technology will enable access to – especially during rather than after purchasing.

32 For more information, the website is here http://www.leafuk.org/leaf/consumers/theLEAFmarquecons/whoproducesit.eb (accessed 13/12/2010)
33 Care Trace is a further example of an organisation, which seeks to tell consumers the story of a product, and relies on barcode technology and the Internet to do so. http://www.caretrace.com/index.aspx (accessed 13/12/2010)
5 Conclusions

This chapter has focused upon food supply chain stakeholders’ (retailers, manufacturers, producers & certification schemes) perceptions and experiences of signally information about food to consumers. The food supply chain stakeholders include producers, manufacturers, retailers, certification schemes and NGOs. In particular, the stakeholders’ perceptions of the strengths and weakness of signals based on certification schemes such as logos have been explored. This has led to assessing what additional methods and practices are used to transmit information to consumers about food. How these alternative approaches are enacted, for example, by corporate social responsibility agendas, in-store campaigns and brand management were covered in the previous sections.

Retailers and manufacturers are among many of the stakeholders within this chapter who have the task of signalling information to consumers. The key challenges around signalling information to consumers faced by stakeholders include: the minimal time spent by consumers during food purchase, the minimal space afforded by the physical label on food products and the complexity that exist behind some signals.

Certification schemes are a useful tool to communicate signals both business-to-business and business to consumer. In particular, the logo provides an everyday assurance to consumers. In situations where greater levels of assurance are required, stakeholders such as certification scheme owners, rely on the citation of standards to provide precise information regarding practices and processes of production. The third party role of certification schemes and their auditing processes provide a form of external legitimacy for the offerings by manufacturers and retailers to their customers.

Signals are diverse and in this chapter, the signal areas identified included: Food safety and food quality, for example, composition, nutrition and health; food integrity, for example, origin, environment process production methods and impacts, ethical and social, for example, animal welfare, fair trade and, cultural and social signals.

Some information areas are challenging for stakeholders to communicate simply and clearly to consumers. Key signals discussed in this chapter included: food safety, origin, environment process production methods and impacts, animal welfare, fair trade. While the complexities surrounding the methodology and different approaches to environment related signals were cited as a challenge by some stakeholders, others placed more emphasis on the potential of signal conflict, as in the case of food safety and animal welfare.

The stakeholders featured in this chapter did not consider the development of omni-labels as a means to overcome the complexity of signalling a set of diverse information sets an effective response. A key consideration was the potential lowering of standards to enable omni-labels to encompass a multiple criterion.

Instead, stakeholders stressed the importance of gaining a balance between too much and too little information provision to the consumers. Practical considerations, such as the limited space afforded on packaging, time constraints experienced by consumers and the need to reduce the potential for consumer confusion were reasons cited by stakeholders for the importance of clear and consistent
signalling. Recognition was also made however of the diversity of consumer’s information needs and consumers’ ‘right to know’ about their real or potential food purchases.

While the use of certification schemes and their associated logo were held by stakeholders to assist in the management of the signalling and information provision, a broader strategy adopted by stakeholders, termed here as ‘information editing’, featured in the management of signals. Information editing refers to the use, presentation and accessibility of information and how stakeholders edit and translate that information. For example, the presentation of information as a story may allow for coherence and compatibility around signalling and thus negate the confusion and tension created from too much information.

Choice-editing with the broader messages displayed in-store was a further measure considered to overcome challenges of information provision. Non-label methods of signalling were emphasised as an important method of ensuring good communicative practice with consumers. Examples include the provision of post-purchase information available on websites and telephone care lines.

The future of product based information and signalling may witness an increase in the use of technology, such as hand held devices that recognise product barcodes and use RFID. This will also make greater use of traceable information.

In conclusion, stakeholders’ perceptions and experiences of signalling information to consumers reveal much about food transparency. Firstly, transparency concerning food involves significantly different types of information and signals linked to: food safety, food quality and food integrity. The scope of information given and the subsequent signalling creates a significant challenge for those involved in communicating to consumers.

Secondly, and most significantly, transparency enacted by stakeholders represented in this chapter is enacted through processes of information and signal management. The extent to which this responds to and fulfils definitions of transparency in terms ‘accessibility’ can be questioned. The role of food chain stakeholders as ‘information editors’ and brokers is important and needs to be acknowledged in the review of the state of current food transparency.
B CONSUMER REQUESTS, CONTEXTS FOR SUCH REQUESTS AND PRIORITIES

ABSTRACT
The work provides the mapping for information disclosure and handling of increased transparency in food chains. It draws on an extensive analytic effort of extant knowledge and the interpretation of such knowledge. It commences with an overview of information/signals (label/non-label). It progresses on reviewing insights from a number of scientific disciplines and develops a theoretical framework for disclosure of information/signals for increased transparency. This framework discusses the content of information to disclose; what criteria such information should adhere to; the process of identifying what to disclose, who, when and how to do so; the handling of ‘targeted transparency’ and the metrics for measurement of the success of a transparency effort; the importance of trust elements, particularly the influences of trust in information characteristics, risk-related characteristics, institutional handling characteristics, and trust in information sources; and well as the consumers’ perceptions regarding industry/retail and stakeholders’ motives.

1 The aim
Following an extensive review of available food consumer behaviour and other domain (i.e. disclosure/governance, economics of information, behavioural psychology, etc) literatures, the present work attempts to describe, decode and interpret extant knowledge in order to produce an explanatory framework that can provide useful insights on the issue of consumer-related food transparency and a roadmap of priorities, experiences, requests and their context for lay consumers as well as specific vulnerable groups. The work particularly looks at information/signals regarding logistics, authenticity and fraud avoidance, geographical origin and PDO/PGI/TSG, production process (e.g., organics, special feed), satisfaction of environmental standards or social/ethical (e.g. labour standards, fair trade, animal welfare etc.) traceability, nutritional and ingredients composition, but also explains the interface of the above with the currently available food information transmission standards and IT technologies. Given that a classic meta-analysis, also probably characterised as quantitative synthesis, primarily refers to a set of statistical procedures that combine the results of multiple studies in a single analysis (DeCoster, 2005: 683) is side-lined for what is needed at the present state of affairs, the effort here is directed to conceptually meta-analyse current research assessing and interpreting content, portray conceptual relations and promote contextualisation. Important to the interpretative ability of current knowledge on food consumer behaviour comes through the lens of knowledge developed in the domain of governance regarding full disclosure of information (see Fung et al., 2007). The need for such a procedure is reflected in Korthals’ (2007:636) comment on the food transparency issue discussion still being in its infancy. Past efforts have much progressed on assembling knowledge on individual safety, quality or nutrition information/signals aspects without attempting to combine available knowledge for all three aspects above together; even more, not attempted to view these, or interpret them, through a food transparency framework. Under the circumstances, namely the lack of extant conceptual frameworks, this attempt aims to synthesize through ‘describing, decoding, translating and otherwise come to terms with the
meanings of certain more or less natural occurring phenomena in the social world’ (van Maanen, 1979). The present effort aims therefore to provide an explanatory framework for the issue; in other words expose a view of the components and a likely ‘engineering mechanism’ that can describe this complex phenomenon.

2 Defining and delineating

Although the focus of any discussion on transparency in food chains can be less on signals that relate to business practice and integrity or competitive behaviour (such as price differences, brand values and meaning) and more on information/signals that relate to logos and certification schemes, the issue faced in the present work task is the actual and genuine mixing of these in consumers’ interpretative practices and behaviours. This issue is delicate and challenging because information concerning food and food practices also overlaps with company brands’ presence in the market place as part of individual organisations actions to build and maintain their own competitive advantage. As it is also generally commented, brand strategy for say, a global manufacturer or a corporate retailer, can incorporate the utilisation of third party certification schemes with their respective logos as well as other food supply management to provide signals and messages about their food product offering to consumers. This actual and genuine mixing in-avertedly causes a genuine problem of boundaries’ delineation regarding any consumer behaviour information/signals (label/non-label)-based transparency related discussion. On the other hand, as regulating on individual company strategy aspects are assumed here to be considered at present as a ground beyond the remit of public policy and regulatory frameworks, the discussion in the present effort needs to be careful regarding what is an ultimate fine line regarding transparency issues revolving around brands’ market presence, brand strategy, brand personality/imagery/information transmit-ability and brand management per se. So, lets’ commence with a definition. Transparency can be defined in multiple ways, but it can also be seen as ‘a condition allowing light/sight to pass through, so that bodies can be distinctly seen through, being evident, obvious and easily understood’ (Oxford, 1990).

Given therefore, that brand management and brand strategy can be seen as a primarily individual firm business domain decision, brand aspects are included in the discussion of the content of information/signals to consumers and how they interface with such information/signals (label/non-label) for clarification purposes, but are not included in the subsequent explanatory consumer related food transparency framework. Although subject to pertinent legislation, pertinent regulations and probably sector voluntary boundaries, brand management and strategy and the imagery linked to them (van Dam and van Trijp, 2007) appear being much of a firm issue in terms of intention, practice but also repercussions -if problems; thus individual firm-owned brand (equaling an individual organization controlled asset for the creation and capture of incremental value to its own shareholders (Allen et al., 2008: 783) related transparency may be allowed at present a distinct consideration and outside the effort of a much needed initial theoretical framework. Although brands and information/signals (label/non-label) interface and can overlap, they are still two distinct domains. Brands can be conceived as information-based (Allen et al., 2008: 784) or signal-based. But, there is also a large number of non-brand information/signals (label/non-label) (an indicative list is provided later). Our translation is that a food consumer interfaces in its encounter(s) with a physical food product through both its brand related aspects and non-brand information/signals (label/non-label). Such information/signals are assumed to be quite easily used by more than one food
manufacturer, while brands are assumed to be proprietary and thus non-imitable by other manufacturers. As an example, nutrient composition (macro or micro-nutrients) can be used by all manufacturers. The fair-trade logo in coffee products is also for instance used by multiple manufacturers irrespectively of their individual brands.

The domain of brands is as complex an area as culture (see for instance Brown, 2006), thus caution is eventually needed at the present state of knowledge-development. The problem probably resides on consumer interpretation grounds where the meanings between brand and non-brand information/signals, and their respective distinct individual imagery, can overlap, replace, substitute, receive greater/lesser attention, be understood easier or not, liked more/less, used more/less in decision making for purchase and/or use. Given the complexity of the individual subject foci, attempts to untangle component elements and explain the 'engineering mechanisms' for transparency need to proceed with wisdom and caution. The same elements can be seen under a brand-related lens and/or non-brand lens. A representative example may be for instance, information about food origin. Although a non-brand issue, it can easily become an inherent component of a company-owned brand. Thus, discussion on transparency can thus progress at present on non-brand aspects before potentially, if judged later necessary by the respective stakeholders, turning in the future towards brand-aspects.

3 Information/Signals (label/non-label ones) of transparency

3.1 Brands

A brand is defined by the American Marketing Association as a ‘name, term, sign, symbol, design or combination of them intended to identify the goods or services of one seller, or a group of sellers and to differentiate them from those of competitors’ (AMA, 2006; Aaker, 1991; Blois, 2000). The legal term for brand is trademark and can come in different forms, formats and/or visual styles (Keller, 2003; van Dam and van Trijp, 2007) and these ‘augment’ (i.e. expand, refine, symbolize) identifiable products and/or services in such a way that the buyer or user perceives relevant unique added value that matches their needs more closely (De Chernatony, 1992) and receives functional and psychological benefits s/he has paid for and has a right to expect (Hankinson, 2002; van Dam and van Trijp, 2007: 154). Brands have received much attention in managerially directed disciplines and topics discussed include brand value, brand equity and their measurement, brand accountability, brand leverage and architecture, internal branding, brand co-creation (with customers), and (strategic and/or tactical) brand management (Allen et al., 2008: 781). Brands have also received enormous attention in consumer psychology with a large number of topics discussed, cursorily including: brand awareness, brand knowledge, brand processing cues, brand personality, brand image, brand associations and perceptions, brand attitudes, brand evaluation, brand feelings, brands’ relationships with customers and brand co-creation, brand loyalty (see Journal of Marketing, Journal of Marketing Research, Journal of Consumer Research for individual contributions and description of literature on each individual focus).
3.2 Information/Signals (label/non-label)

Some of the definitions provided include, for instance, a) regarding ‘information’: ‘A telling or being told of something; new/ intelligence/word; knowledge acquired in any manner (Collins, 1978)’; ‘Something told/ knowledge; items of knowledge/news (Oxford, 1990)’; ‘Anything that informs or produces a difference in knowledge or understanding; and can be found in many forms (Jaeger et al., 2005: 277)’; b) regarding ‘signal’: ‘An indication; a sign/event fixed or understood as the occasion for pre-arranged combined action; anything which occasions a certain action/response; a sign given by gesture, flashing, light etc to convey a command, direction, warning etc or an object/device providing such a sign (Collins, 1978)’. Related adjectives include: ‘not average or ordinary; remarkable; notable.

Verbs include: to make known or communicate (information)’; ‘A sign conveying information, guidance etc especially at a distance; a message made up of such signs; an immediate occasion or cause of movement, action (Oxford, 1990)’; c) regarding ‘label’: ‘A card, strip of paper etc marked and attached to an object to indicate its nature, contents, ownership, destination etc; a descriptive word or phrase applied to a person, group, theory etc as a convenient generalized classification; an identifying brand (Collins, 1978)’; ‘A small piece of paper, card, linen, metal etc for attaching to an object and giving its name, information about it, instructions for use etc; A short classifying phrase or name applied to a person, etc; the logo, title or trademark. The verb labeling includes assignment to a category (Oxford, 1990)’.

The above seem to indicate three, at least, elements. First, information exists after being ‘recorded’ in a spoken, written or visual form and has the potential to make a difference in understanding and/or knowledge. Otherwise, we interpret that this can be only ‘data’ assumed as ‘inferior’ and ‘lower-grade’ to information for the purpose of understanding/produce knowledge (i.e., data leads to information that lead to knowledge). Second, signals encompass/embed information to convey messages for direction and/or certain action/response. Third, labels also appear to be signals but they are attached to/recorded on objects; likewise information can also be recorded on objects with the potential to inform, classify, develop knowledge about or direct. Important also, in the definitions above, is actually the availability of information/signals (label/non-label) to final consumers/users for the purpose of their individual decision making/ consumption and ultimate use. Some of them may however, never be used by consumers because they are outside the domain of their understanding or required knowledge. Moreover, some may be of routine nature in daily food business operations/processing; others being of non-routine nature (equalling ad hoc occurrence). Third, labels contain signals or information. This means that we are permitted to define here labels as grouping signals/information, in other words labels are a composite set of constituent parts of signals/information which are at a higher level of abstraction and thus supersede subsume such individual constituent parts. Their composition shapes up to different and distinct ‘totals’, each one of them being a different label. Adopting the above stance allows us to go back into handling signals/information only as a central element in our discussion for disclosure and transparency. Given also that signals do also convey information for a purpose, it looks like, we do in essence still in fact and eventually genuinely focus on information only. We will keep using the terminology throughout the text though as information/signals for communication purposes though.

Table 1 below provides a comprehensive list of information/signals alongside additional elements, namely: a) Intended purpose of its existence and of ‘routine’ versus ‘non-routine’ nature; b) Likelihood to trigger consumer (mis)trust, thus becoming the focus in case of a ‘transparency’ investigation.
Attention is needed regarding the overlap with brand issues though. Given the range of ways communication can adopt, information can be signalled to consumers: a) through the food product itself at the point-of-sale allowing a direct contact or sensory experience; b) from close proximity methods, like in-store allowing a subsequent immediate consumer direct contact with the product or sensory experience; c) from distance not allowing a subsequent immediate contact or sensory experience either through media/advertising or website. It is generally accepted that labelling may be communication of information to consumers ultimately via the product itself. The different types of signals are as numerous as the methods and systems used to transmit signals to consumers. Yet, these can still broadly be categorised as information/signals (label/non-label) under the headings of a) Food Safety; b) Food Quality (including composition); and c) Food Integrity. Information relating to the existence of a consumer phone/line is a signal on its own, but is seen as related to providing further details on any one of the previous three categories. Table 1 (below) encompasses material from other researchers and other relevant information derived from other WPs of the Food Transparency project. They are not singly linked to schemes alone, given that consumers are not necessarily clear or interested in schemes alone. Furthermore, some schemes have more than one aim within their scope of existence. The picture is also confusing since there is a variation in what signals are enacted in certification and assurance schemes as well as their strength in consumers’ cognitive maps. For example ‘organic’, as a signal communicated to customers via a logo, may be underpinned by a certification process that includes a focus on animal welfare, ethical and fair treatment of workers as well as environmental goals such as maintaining biodiversity. It is also clear from the investigation of the contents of the table that a large of information/signals overlap with brands’ issues and brand firm-driven related strategy and management decisions.

**Table 1**

<table>
<thead>
<tr>
<th>Area</th>
<th>Information/ signal area</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Safety</td>
<td>Chemical hazards</td>
<td>free from or compliant with: Heavy metals, combustion pollutants (PAC’s, PCB’s dioxins), pesticides, veterinary pharmaceuticals, nitrates, SO2, process-derived hazards, packaging migrants</td>
</tr>
<tr>
<td></td>
<td>Biological hazards</td>
<td>free from or compliant with: Microbial pathogens, microbial (incl. fungal) toxins, allergens, plant toxins, shellfish toxins</td>
</tr>
<tr>
<td></td>
<td>Analytical considerations</td>
<td>recognition of rigor / accreditation; official (ISO standards) and commercial (e.g. Campden) (e.g. availability, accuracy and limitations, detection limits)</td>
</tr>
<tr>
<td></td>
<td>Primary production</td>
<td>GM / non-GM, country source as safety-relevant</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td>Traditional/emerging technologies, combined processes; evidence using measured parameters vs auditing maintaining instructions</td>
</tr>
<tr>
<td>Packaging</td>
<td></td>
<td>Active, novel (retortable flexible), intelligent, migration hazards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Packaging material (glass, plastic, paper)</td>
</tr>
<tr>
<td></td>
<td>Transport/distribution</td>
<td>Transport and distribution; Temperature control, traceability</td>
</tr>
<tr>
<td>Abuse</td>
<td></td>
<td>Adulteration, criminal recycling (re-dating etc) for financial gain; Sabotage by 3rd parties for criminal reasons (financial); Bioterrorism</td>
</tr>
</tbody>
</table>
## Transparency in the Food Chain

<table>
<thead>
<tr>
<th>Organization and discipline (recognition of management practices / systems)</th>
<th>related</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Legal</strong></td>
<td>Compliance with legislation – tacit recognition; product category, animal production, food hygiene (incl. HACCP and traceability)</td>
</tr>
<tr>
<td><strong>Voluntary / commercially-driven</strong></td>
<td>ISO 9001, ISO 22000 etc / Eurepgap, BRC, IFS, BRC-IOP. System 5 - Product certification</td>
</tr>
<tr>
<td><strong>Monitoring schemes</strong></td>
<td>Monitoring schemes (e.g. official food surveillance)</td>
</tr>
</tbody>
</table>

### Food Quality

<table>
<thead>
<tr>
<th>Composition</th>
<th>Containing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contains</strong> XY original ingredients, macro/micro-nutrients; nutrition labels</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health and nutrition claims</th>
<th>Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Free from, reduced content, contains, rich, enriched, good/beneficial for etc</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food content properties and attributes specific for health diets</th>
<th>Utilitarian/hedonic with a specific diet purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Allergen-free; gluten-free</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food sensory properties and attributes</th>
<th>Sensory / hedonic related</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sweet, salty, etc; Awards (Quality/Characteristics)</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Raw material production</th>
<th>Ingredients/product ion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cultivar, quality categories, genetic modifications; content (chicken corn-fed)</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Storage conditions</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature monitoring, Best-before date</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Serving sizes, cooking suggestions, recipe,</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food processing methods</th>
<th>Technologies used</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traditional (e.g. in barrel) vs. emerging technologies</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food packaging and distribution</th>
<th>Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active and intelligent packaging, other than safety aspects, product-packaging interactions</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Authenticity</th>
<th>Fraud avoidance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Numerous aspects</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Origin</th>
<th>Location source of ingredients/production</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin: Place or production; country (country-of-origin/Made in). For certain foods like olive oil, this refers to country of bottling location (eg Italy)</strong></td>
<td></td>
</tr>
</tbody>
</table>

<p>| Food integrity relating to | Origin refers to mere mentioning of origin issues; Integrit Y: Regional product/terroir. Includes PDOs/PGI/TSG. |</p>
<table>
<thead>
<tr>
<th><strong>origin</strong></th>
<th><strong>integrity refers to respect of specific origin related practices</strong></th>
</tr>
</thead>
</table>

**Food Integrity**

<table>
<thead>
<tr>
<th><strong>Production Process Method focus</strong></th>
<th><strong>Organic; Soil Association</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated Farm Management; LEAF</td>
<td>Leaf marquee (scheme: follows practices of integrated farm management) signalling that biodiversity and the limited use of pesticides has been maintained throughout production</td>
</tr>
<tr>
<td><strong>Sustainable sourcing policies</strong></td>
<td><strong>Carbon Footprint Labelling including emissions in CO2</strong></td>
</tr>
</tbody>
</table>

**Ethical and Social**

<table>
<thead>
<tr>
<th><strong>Ethical and Social Animal Welfare; Terms of trade</strong></th>
<th><strong>RSPCA Freedom Foods; Fairtrade Labelling Organisation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Social and Community Capital</td>
<td>Rainforest Alliance</td>
</tr>
<tr>
<td>Cultural and Social – Production Method</td>
<td>Kosher; Halal; Vegetarian; Vegan;</td>
</tr>
</tbody>
</table>

**Other**

<table>
<thead>
<tr>
<th><strong>Other</strong></th>
<th><strong>Responsible behaviours (e.g. drinking)</strong></th>
</tr>
</thead>
</table>

**Support (Company)**

<table>
<thead>
<tr>
<th><strong>Personal or impersonal contact</strong></th>
<th><strong>Consumer phone line, leaflets, web-based information</strong></th>
</tr>
</thead>
</table>

Source: Material from other researchers and other relevant information derived from other WPs (WP4 and WP5.1) of the Food Transparency project

### 3. 3 Use of information/signals: Distortions, complexities and imperfections

The transmission of appropriate information and signals from food value chains to the consumer, based upon clear transparency practices and traceability systems, is an integral element in establishing and maintaining the European public’s trust in food – where the public are both consumers and citizens. As mentioned earlier, transparency is defined here as a condition allowing light/sight to pass through, so that ‘bodies’ can be distinctly seen through, being evident, obvious and easily understood (Oxford, 1990). Appropriate information and signals have become however, as Table 1 clearly suggest, a complex and strong debated field as governance, consumer and retail, industry/technology with no clear convergence; instead further schemes are currently in development, so divergence instead of convergence characterises today’s marketplace. Lay people
appear to be overwhelmed and confused by much added information and labels on food product packages-based, through the internet or using other methods (e.g. information kiosks) to which they are exposed; consumers may in fact actively search in limited ways or understand only parts of the signals/information they are exposed to; and eventually make partial use of information/signals. Furthermore, multiple breaks in the information chain may exist and the final consumers may not be able to obtain the information they consider necessary when they so wish. Even further, when these issues are examined in detail and at individual decision-making and use level, additional complexity obscures further the picture. For instance, their understanding may be either subjective (the meaning the consumer attaches to the information/signal) or objective (whether the consumer’s understanding of the message is compatible with the intended meaning) component; consumers may infer a meaning by relating the information to pre-existing knowledge, and they may eventually make choices because they like the imagery of a particular label (Grunert and Wills, 2007). Sometimes, consumers may even make choices without the use of information/signals on the basis of pre/existing heuristics (Goldstein and Gigerenzer, 2002), despite many of them claiming that they do not do so. At the same time, public policy-makers and regulatory agencies are increasingly reliant upon the effective actions of the food supply chain to deliver effective signals as to the origins and qualities of the food produced, in both product and process terms, in order to realise the regulatory objectives of EU law. Implementation of these is hindered by obstacles, because of:

- the multitude of standards, and numerous certification and labelling schemes emerging from different sections of the food supply chain as well as from stakeholders.
- the ultimately overlapping nature of different information/signal domains such as environmental and natural resource protection (e.g. biodiversity impact and integrated farm management and organic farming processes; sustainable fisheries and growing interest in embedded water), climate change and energy use (carbon impact, food miles), food safety (food hygiene), public health through dietary goals (nutritional content and nutrient reformulation of food products), and social and ethical issues (e.g. labour standards, fair trade, animal welfare, geographical origins).

These happen when there is evidence that information/signals must be made available as they may be an integral part of many consumers’ everyday life like in the case of the increasing number of allergy sufferers (Cornelisse-Vermaat et al., 2008). Thus, questions arise as to the effectiveness of these systems and their signals in: a) achieving their goals of informing consumers and their behaviour and how these match consumers’ desires; b) the working of the transparency and implementation through traceability systems for producing the types of information and signals sought in terms of validity and reliability; c) the nature of their contribution to public policy goals.

### 4 Alternative viewpoints

Next, the complexities related to individual consumer-making and use are discussed, but also the imperfections of real business life faced by manufacturers and retailers alike in their efforts to supply consumers with pertinent information. The discussion intends to provide a picture that comes out of the analytic effort undertaken for the purpose and provide an indicative picture of the inherent difficulties in understanding consumer behaviour elements for food transparency purposes. Four borderer disciplines/literature domains are particularly close to the investigated area, namely
economics of information, information/signals related behavioural psychology, governance and food risk communication.

**Industry complexities and imperfections - the side of supply chains’ decision making:** Industry-based complexities and imperfections do exist in supply chains’ attempts to satisfy expected consumer needs. The main issues are, in a summarized form, the following:

- Legal obligations prevail, but the diversity of consumers motivations on the level of detail, and ability of traceability systems to make such detail of information available, first make such provision only a goodwill intention, but impractical in implementation. Tensions are substantial with how much to provide, the time available for the provision and the space available for the purpose.
- Confidence is first built in business-to-business transactions with specific aims. First, to minimize potential risks; second, retailers and manufacturers alike become re-assured (assumed here to regard their ability to defend themselves in case of problems and litigation); and third to follow evolving social needs, goals of stakeholders as well as pre-empt, or respond to, competition.
- Third party certification fulfils an external social and business environmental adjustment as it demonstrates aligning and complying with evolving best practice in each sector. In some cases, such information/signals become widespread (like in fair-trade coffee) that their use is a de-facto practice and expected reference point. Yet, a general hypothesis is that recognition of logos rather than their meaning and understanding is a key function in this respect.
- A piecemeal approach to certification and Commodities is inevitable given the complexity of the food trade and manufacture, but may drive cross-fertilisation of practices and omni-label schemes across Commodities. A piecemeal approach is also currently in practice on communication issues to consumers.
- Food safety is an area with absence of competitiveness as unsafe food products cannot exist on the market anyway. Food quality, namely origin labeling rules still lagging behind current industry practices, so they create problems. Environmental signals face substantial complexities, lack of methodologies and the exact range of pertinent issues.
- An increasing burden is also evident regarding the standards which certification schemes rely upon and their proliferation. Information editing, choice-editing, categorization or taxonomies of information and data organisation that need convergence are opposing force to substantial divergence in intentions and proliferation of label/non-label schemes. Interestingly, information and choice-editing is evidently overlapping with brand issues.

**Economics-derived, psychology-derived insights - the side of individuals’ decision making:** Under traditional (micro)economics, information/signal related *individual* decision-making is explained through normative theories of judgement and choice, typical probability rules and utility theories with primary aim to test the systematic violation of such rules (Edwards, 1961); a widely recognisable result has been the advancement of ‘heuristics’ without actually explaining what heuristic applies to what content/context. Given the long-held assumption in economics that although individuals may behave erratically, their *overall market-level* and thus *policy-implications level* behavioural model of
choice-maximisation and well informed preferences is still approximately right, had as impact the
tenet that better models of individual decision making may not improve market-level prediction
(Camerer, 1995; Friedman, 1953; Plott, 1986). At the same time, only during the 1970s, psychologists
started focusing on judgement errors (Camerer, 1995: 588; Kahneman and Tversky, 1982). Discussion
on judgement of information looked at several issues and has a long history. These include
indicatively, the following aspects:

• First, issues of numeracy (number related information) and self-‘calibration’ (Lichtenstein
  et al., 1982) showing individuals’ increasing/decreasing confidence on the actual
  likelihood of what they see regarding food origin; exaggerating or self-penalising when
  they report their beliefs (e.g., Fisher, 1982; Jensen and Peterson, 1973); or eliciting
  confidence intervals for information on quantities instead of probabilities of events (e.g.
  Alpert and Raiffa, 1982; Griffin and Tversky, 1982).

• Second, individuals’ systematic error making when they process information. For
  instance, people more often err by mistaking unfamiliar patterns for familiar ones than
  vice versa (Bruner et al., 1951), retrieving easier the most and least pleasant memories
  (Holmes, 1970); these eventually establishing a rule of individual decision-making on the
  basis of random availability of information (Tversky and Kahneman, 1973). At the same
time, media distortions on risk-related events’ information (Combs and Slovic, 1979)
distort consumer exposure through an uneven account of information on risk-issues.

• Third, individuals’ treatment of numbers’ related information in their daily life exhibits
  substantial and systematic biases. For instance, individuals’ recognition and handling of
  simple calculations shows information on uncertainty is systematically underweighted
  (due to underconfidence) or overweighted and that individuals use different decision
  rules in different uncertainly assessment situations (Grether, 1990); or because of
different linguistics (Krosnick et al., 1990; Tversky and Kahneman, 1983). These may
result in systematic consumer interpretability-related conjunction fallacies. Small
numbers also confuse people as individuals have a tendency to generalise from small
samples and misconceive randomness (Tversky and Kahneman, 1971), indicating that
consumers may be likely to generalise across foods and many food categories what may
in fact be information/signals pertinent to only a small number of foods/food categories.

• Fourth, individuals’ learning is biased; example is the confirmation bias suggesting that
  individuals expect their rules to be confirmed by events, but may not test if their rules
  are actually true; furthermore their belief in an information be true inhibits their learning
  whether their underlying belief is false (Camerer, 1995).

• Fifth, rational expectations rules are violated through individuals’ inefficient use of
  observable information. In other words, the use of additional information increases the
  number of potential perceived interactions as well as the use of unrelated elements in
decision making (e.g. Dawes et al., 1989; Camerer and Johnson, 1991).

• Sixth, individuals use their own tastes and beliefs as information in guessing what others
  like and believe (Ross et al., 1977) while, at the same time, these are also
misinterpretation of past events (Hawkins and Hastie, 1990).

• Seventh, but particularly important for the focus subject, is individuals’ handling of their
  feeling of control and a resulting illusion. The issue of ‘control illusion’ may have much to
do with transparency. Individuals enter in negative moods when they feel in no control
of events (Taylor and Brown, 1988). Individuals appear to penalise an agent when a
signal appears to be outside their control as they appear to feel their effort is pointless or
subject to unfairness imposed upon them. This happens when individuals are interested
in keeping control of an event, thus they are interested in their own personal full distinctly seeing and understanding of information/signals surrounding the particular event(s). Actually, this view is also coherent with research findings in the risk analysis and risk communication literature. Risk perception research has shown that consumers are concerned about the controllability of hazards (both in terms of their own exposure to them, and by regulatory authorities more generally), and that perceptions of controllability, and whether they perceive that they are involuntarily exposed to a hazard, are important determinants of risk acceptability (e.g., Fischhoff et al., 1978). This drives consumer reactions. Van Kleef et al. (2007) for instance comment that ‘perceptions of personal controllability over exposure to a hazard can determine the extent to which consumers need to rely on institutional risk management (Frewer et al., 2004; Van Kleef et al., 2006)’ or can eventually decide to react themselves by for instance not proceeding to purchases in case of a –perceived- escalating inability of the institutions to control incidents. The past occurrence of various food safety incidents has led to an international impact on consumer confidence in, and economic functioning of, the food chains affected (e.g., BSE and dioxin contamination; Verbeke, 2001) through lack of consumer purchases. Such lack of consumer purchases can easily be translated as evidence of consumers’ reaction to events. These elements are complemented by choice-related prospect theory issues (Tversky and Kahneman, 1986). The series of consecutive choices made by humans are suboptimal if the perceived value function of an event relates to losses than gains. It looks like individuals’ value functions in consecutive choices have two important properties: a) are steeper around a reference point for losses than gains (‘loss-aversion’), and b) risk attitudes “reflect” around the reference point. The value function is concave for gains (risk-averse) and convex for losses (risk-seeking) (Camerer, 1995). Elicitation biases are relevant here too. Utility of information/signals and the probability of a consumer (re)action is characterised by different levels of marginal reactivity. Individuals’ derived utility appears to vary with the procedures eliciting it and the perceived location of risk aversion on its own non-linear in nature curve (Hershey et al., 1982; Wolf and Pohlman, 1983).

- Eighth, research on heuristics confirmed their existence in food consumer behaviour too. For instance, van Kleef et al. (2007) reviews ‘that consumer decisions about food safety are often based on heuristics or cues associated with information or messages (Frewer et al., 1997). Heuristic processing occurs when people use simple cues or decision rules to make judgments about the merits or otherwise of information, without recourse to thoughtful analysis of the information content (Chaiken, 1980; Eagly and Chaiken, 1993). In contrast, systematic in-depth processing occurs when people are motivated to process information in a thoughtful way, utilizing cognitive resources. In these latter circumstances, external cues providing information about the merits or otherwise of the information become less salient. Heuristic approaches are adopted because people often lack knowledge, motivation, capacity, or other resources to make decisions about the risks and benefits associated with a new technology or food hazard, and people may then base their judgments about the acceptability of risks on assessments of those who are responsible for managing the hazard (Siegrist and Cvetkovich, 2000)’.

Thus, trust and appropriate risk communication does help to reduce concerns about risk uncertainty to an acceptable level, and to simplify decisions involving a large amount of information (Savadori et al., 2004), thus leading to consumer satisfaction with information disclosure practices and extant transparency in food chains. The last two points (seventh and eighth), probably provide evidence of systematic psychological biases in individuals/
consumers interfacing with the food supply chain that can guide the discussion of transparency in food chains and the development of a theoretical framework for the purpose. For instance, it is probable, that once a development/event linked to information/signal (label/non-label) triggers consumer attention, is of negative nature and consumers feel that they have no control, and that their (re)action effort is pointless/unfair, this triggers a chain crisis reaction, formation of concerns and request for greater transparency so to enforce personal consumer control over events and their outcome. At the same time, escalating of a crisis with consecutive negative information triggers a continuing steeper and adverse reaction with increasing negative utility. At the same time, even though transparent, the disclosure of positive nature information/signals may have and outcome way that is marginally weaker than the outcome of negative information/signals when these occur. Furthermore, increasing citizen/consumer worries and concerns over environmental, ethical and social issues trigger requests for implementation of information/signals frameworks targeting the elimination of negative nature events occurring.

**Governance-derived insights:** Governance literature also provides substantial value insights to transparency and disclosure issues. Governance has realised that fundamental information imperfections govern exchanges in economic and social systems and radically change business and consumer behaviour(s). The reasons (see also Fung et al., 2007) have to do with the following. First, consumption of new information is not actually spread by information providers equally to all involved parties and that private parties, even with coordinated activities have difficulty of overcoming the problem of providing public goods like information (Olson, 1971). This leads to real-world actual underproduction of information. Second, Akerlof’s (1970) ‘lemon’s problem’ and ‘adverse selection’ is a fundamental component of business life and exchanges, thus also exchanges with consumers. Adverse selection has to do with inherent market uncertainties about the objectively actual characteristics of (food) products, beyond those expressed by a price and readily observable characteristics by (food) consumers, leading to information asymmetry and widespread sub-optimal exchanges. This leads to real world likelihood of cost penalization of those (food supply) firms providing information. Third, ‘moral hazard’ issues (also see Macho-Stadler and Pérez-Castrillo, 2001: 37) which introduce suspicion on the incentives of (food supply) parties to engage in desired behavior(s) since such exchange parties do actually have different incentives to resolve information asymmetries.

**Food risk management, communication and risk analysis-derived insights:** Risk management is one of three primary activities in the current process of risk analysis, the other two being risk assessment and risk communication (FAO/WHO, 1997). They identifies that the primary goal of food risk management is the protection of public health by effectively controlling risks through the selection and implementation of appropriate measures. Risk managers have the obligation to consider the various legal, political, social, and economic issues, such as risk acceptability and policies for risk mitigation activities. Within this frame, risk assessment focuses on estimating the risk that a hazardous event will negatively affect a population or subpopulation. Risk communication is seen as the interactive exchange of information expressed through opinions concerning risk and risk management among risk assessors, risk managers, consumers, and other stakeholders. As such,
communication is not a single independent component, but interacts with both assessment and management. The recent adverse impact of perceived food crises (e.g., BSE) has raised substantial consumer concern on the effectiveness of food risk management (Verbeke, 2001) and has resulted in changing its governing principles and practices as well as pertinent institutional arrangements for food safety in Europe (Houghton et al., 2006; 2008) and beyond (Yasui, 2004). These crises have also propelled the request for greater openness and transparency in policy making for increasing public trust (Byrne, 2002; Rowe and Frewer, 2000; Walls et al., 2004). Actually, one of the publicly stated drivers for creating the European Food Safety Authority, was to encompass the concept of transparency and transparency in the development of food safety measures based upon integrity, independence, and putting the consumer first (Byrne, 2002; Wales, 2004). Increasing however, transparency in regulatory measures in itself may not improve public confidence in risk analysis practices (Frewer, 2004), but increases public scrutiny opportunities of the values and activities included in the practice of risk analysis (including those values applied and activities for risk management and risk communication) (Frewer, 2004; Jensen and Sandoe, 2002); thus information disclosure thereof.

An important finding of prior research is confirming the divergence of opinion between stakeholders. What the public perceives to be best practice in risk management (thus, what is the content and process of disclosure for transparency to them), ultimately leading to increased consumer confidence and restoring public trust in institutions with responsibility for consumer protection in the agri-food sector, differs from perceptions of “experts” (e.g., Slovic, 1987; Douglas and Wildavsky, 1982; Houghton et al., 2006; 2008). Research showed that experts tend to believe in the rationality of arguments, facts, and science, arguing that science in itself provides an adequate and sufficient safeguarding. This view in contested by food consumers indicating major inefficiencies in an expert-only (or food supply chain experts-only) based information disclosure practice. Linked to this is trust (see later for an explanation) that influences the level of required information disclosure and perceived transparency. In a formation of a likely vicious circle, rather than assessing all relevant information, and in parallel and related with what is the public perception of food hazards (Boholm, 1998; Fife-Schaw and Rowe, 1996; Hansen et al., 2003), consumers link their evaluations of food risk management quality to the extent to which they can trust in those food chain actors with responsibility for consumer protection. Decreased trust may well link to exaggeration of perceptions of public hazards and feelings of lack of controllability of associated risk. These tenets can form the basis for the development of a food transparency framework explained below. This model framework can also explain the ‘engineering’ (i.e., the mechanism) of handling transparency within the food chains and how to intervene to reverse negative consumer feelings and subsequent (re)actions.

5 Transparency regarding information/signals –A meta-analytic framework and its basic tenants

Greater disclosure may lead to greater transparency for the final food consumers: The primary point of departure in our attempt to highlight certain conditions whereby consumers wish to witness disclosure of information about their food products in order to fulfil transparency. This is a basic premise for a consumer-transparency-request and requires the activation of conditions where
consumers engage in searching for cues which will allow them ‘light’/’sight’ to pass through, so that ‘bodies’ can be distinctly seen through and easily understood (Oxford, 1990). Thus, handling of, and increased, transparency is seen as achieved when the engineering/mechanism surrounding components allows ‘a distinct’ seen-through and easy understanding by the final consumer. Disclosure of further information and details becomes central when such need for ‘seeing through’ is deemed necessary by consumers themselves. The notion of transparency above is one of continuum, ranges from decreased transparency (no consumers’ ability to ‘see through’ information) (assumed to equalling limited disclosure) to increased transparency (equal to greater disclosure and full consumer understanding).

**Routine aspects and ‘positive’ (‘enhancement’) type information/signals:** A second tenant is that not all information/signals will be automatically searched or used by food consumers (for instance, origin of a food product or nutrient-based food composition); thus information/signals of no interest will not be needed under routine circumstances to be the focus for further disclosure and thus increased transparency. A first aspect regard domains of information/signals that individuals may want further information, to be disclosed on, as part of normal routine. Food consumer behaviour literature indicates that a number of well defined and well populated segments are now distinguishable across Europe, and public policy monitoring like Eurobarometer is able to track aspects of increasing public interest for. A large number of such information is already in fact provided as normal practice by the food industry. A classic example for a fresh-milk branded processing firm is mentioning on the milk package the region locations where the farms providing the raw milk are located in. Another example for a smoked/cured bacon producer is the pigs’ rearing conditions or county. Such information/signals are in essence of a ‘routine’ information to be disclosed that leads to final consumer formation of perceptions regarding the branded food product, its COO (country-of-origin effect), and production location, its production process, its composition, the purpose of its use, materials used in its packaging, respect for the environment and sustainability, as well as pertinent certifications. In essence, all these are of a ‘positive’ character and of an ‘enhancement’ nature regarding the relationship between the final consumer and the consumption of the food product itself, but also subsequently with the manufacturer. They explain normal practice/ daily operations and characterize what the final consumers do consume and whom they ‘cooperate’ for the purpose. These establish a consumer relationship with both the brand and the manufacturer (also/or retailer). Transparency issues in such cases are assumed to be of a nature rather ‘confirmatory of the situation’ and of a ‘building/maintaining a bond’ nature. Obviously, given the existence of homogeneous versus heterogeneous segments for food products, their appeal will vary. Some food branded products will appear to larger and more homogeneous market segments, others will appeal to smaller heterogeneous market segments. We have witnessed for instance common substantial homogeneous interest on some food safety aspects (for instance GMO content; BSE) for which disclosure of further details is required in a horizontal manner (across food sectors), but also heterogeneous requirements on other food safety aspects, for instance on analytical considerations. Another example is the increased interest for environmental, ethical and social issues in a number of consumer segments; thus these may become domains that will be the focus for further disclosure of (customised) information exhibiting thus increased transparency in the segments.
Of ‘routine’ and positive (‘enhancement’) character seems to be traceability-systems-based provided pertinent information too; much of pertinent literature advocates that traceability and traceability-based information serve for effective and efficient recalls so to minimise risk in case of food safety aspects, but also for safeguarding and assuring food quality (e.g., Cheek, 2006; Cheng and Simmons, 1994; Clemens, 2003; Davies, 2003; Dickinson and Bailey, 2002; 2005; Dimara and Skuras, 2003; 2005; Hobbs, 2004; 2006; Loureiro and Umerber, 2007; Golan et al., 2002; McKean, 2001; Opara and Mazaud, 2001; Schwägele, 2005; Smith et al., 2005; Timon and O’ Reilly, 1998). Yet, a substantial issue is if traceability information per se is indeed of interest for consumers (Kehagia et al., 2007a; 2007b). These happen for specific reasons. Traceability systems are viewed as an indispensable tool assuring product safety and implementing quality standards inside food chains (Buhr, 2003; Gellynck and Verbeke, 2001; Verbeke, 2001). Traceability systems do not necessarily denote food safety or quality but it is good tool to assure both, particularly to industry and trade per se. Traceability (and traceability systems thereof), in the absence of quality verification, may thus be, of limited value to individual consumers, and for this reason, only if bundling traceability with quality assurances has the potential to deliver more value (Bernues et al. 2003; Hobbs et al. 2005; Kehagia et al., 2007a; 2007b; Verbeke and Ward, 2005) and consumers’ needs for credible and reliable information be fulfilled (Verbeke, 2001). However, an important issue is to identify what type of information needs to be provided through traceability (and traceability systems thereof) and how this information should be provided to them (Roos et al. 2004).

Kehagia et al. (2007a) conducted a systematic analysis of similarities/differences in perceptions of traceability between consumers in 12 different European countries and across different product types. It also offered results on the importance of labels for different product types. Their findings showed that participants could not provide an exact definition of the term and in other cases they were unable to describe it. Moreover, consumers were apparently not fully able to understand the meaning of traceability. Respondents perceived traceability in some similar way in some countries, but also dissimilar in others. However, when they were provided with more information about it and started getting familiar with its use, they valued its implementation in the food supply chain positively. Labels were considered as the most suitable way of communication for consumers, but they were not always understandable or easily accessible for facilitating consumers’ understanding, while other electronic means are difficult to use in their own right (Angeles, 2007; Cap Gemini and Young, 2004). Moreover, expectations and understanding of traceability benefits differed more across countries. In almost all counties participants valued traceability as being able to identify the origin of the product in particular when it was in relation to specific food preferences and cases of food recalls. Traceability could further reassure food quality and safety and at the same time used as a tool to control the production process. Importantly, differences existed among countries in consumers’ perceptions on traceability in relation to the information suggested to be possessed by different food products, but important similarities also existed. Labels have shown to still be a familiar way of securing confidence, although their already existing large number for different schemes (e.g., product of designated origin, organics labels etc) exhibited weakness due to prevailing confusion. The above clarify the link between traceability and traceability-systems. It looks like we still deal with information/signals and that traceability systems are an industry and trade practice and able to be a base for disclosing information for greater transparency as per consumer information needs per se. Traceability and traceability-systems may be seen therefore as a basis for (re)assurance and proactive (see also below) positive information (‘enhancement’ nature) character provision but also minimisation of the impact negative events when and if these occur. Last, but not
least, routine and positive (‘enhancement’) type information is also linked to consumer satisfaction of food risk management practices. The development of proactive measures to prevent large-scale food crises and scandals, rather than adopting a strategy to deal with a problem after it has occurred result in perception of food risk management being effective (van Kleef et al., 2007). What happens is that proactive communication through disclosing pertinent information introduces transparency to consumers about emerging food safety problems, and what is being proactively done to mitigate emerging risks; eventually increase confidence in risk management practices and evaluations of food risk management (Van Kleef et al., 2006). Traceability and traceability-related systems play a contributing role in this respect. These eventually appear to function in a way that turn negative-post-hoc, negative-event related, evaluations into positive ‘enhancement’ information instances.

Non-routine aspects and ‘negative’ type information/signals: A third tenant is the activation of conditions for disclosure of further information for elements when they are not part of routine or they refer to elements of a negative or controversial nature. Information / signals relating to non-routine controversial of a ‘crisis’ or ‘problem’ nature information may trigger consumer attempts to control and feelings of the need for risk reduction, eventually leading to an escalating crisis and difficulties in its management by the respective public authorities and involved supply chain members. For instance, processing facilities/manufacturing firms may face either irregular events or (a) an external nature or (b) linked to their own practices and management. A classic earlier case instance may in milk processing be a blue-tongue or foot-and-mouth epidemic and in the latter case a human mistake or an accident in the processing line that causes an incident. Obviously, the earlier instance cases are of rather of a rare character and precautions taken by the veterinary and public safety authorities lead as at present to their handling that safeguards against their occurrence. So, a question is as not all occurrences relate to epidemics or food crises, when there is a need to raise alertness for further disclosure and transparency to consumers. There may exist however, areas in the safety, quality or integrity domains that may cover ‘grey’ ground. It appears that increased transparency and disclosure may be assumed to exist when information/signals for ‘grey’ nature topics, levels of alertness and reference points eventually meet a number of specific criteria. These are (Fung et al., 2007):

- More than one side of things on controversial issues is presented;
- Forthcoming with information that is damaging to the involved organisations;
- There is openness to criticism;
- Involved actors freely admit when made mistakes;
- Involved actors provide information that can be compared to industry standards, government regulations and stakeholders scrutiny criteria.

Criteria of information and information disclosure for greater transparency: A fourth tenant concerns the criteria to meet, in order to be judged adequate for achievement of greater transparency. It appears that increased transparency and disclosure may be assumed to exist when information/signals are ‘confirmed’ to meet the following criteria (Fung et al., 2007):

- They are provided in a timely fashion ... (‘to... people like me’...);
• They are relevant…(‘to... people like me’...);
• They are comparable to previously available information and firm and industry past performance…(‘to... people like me’...);
• They are complete…(‘to... people like me’...);
• They are easy to understand (thus already attracting consumers’ attention, are readable, are probably liked), and provided in a way that is easy…(‘to... people like me’...);
• They are accurate, defined here as sufficiently concrete…(‘to... people like me’...);
• They are valid and reliable for what they refer to…(‘to... people like me’...).

A question regards the identification of the point of reference, namely what is ‘people like me’. Given the complexity of consumer segmentation, the notion of ‘people like me’ does not probably exist; furthermore, populated segments of people like me’ may well evolve and be transformed over time regarding their exact requirements.

**Process of extracting the manner to follow to identify content:** A fifth tenant regards the actual method and process by which to arrive at the identification of such topics and the content in each topic. Process identification for information disclosure and greater perceived transparency is important. For instance, perceptions of food risk management were found to be related to whether the authorities develop and maintain systems of control, and are transparent regarding the development of these systems and their performance (Van Kleef et al., 2006). These authors distinguishingly identified that consumers perceived food risks to be well managed when control measures are developed to contain the risks, when these measures are rigorously enforced, and when people are aware of the measures being developed. All these in-variously reflect and / or contain process elements. Identification of the process for disclosing information for greater transparency is expected to lead to what exactly to disclose, who, when and how will do so. It will also include whether stakeholders and especially consumers themselves or through their assumed representatives (e.g., consumer organisations) will actively or passively participate in the identification of such content. Last but not least, these processes will also identify the communication and technological means (e.g., web-based versus other means) to use for the communication of disclosed information. Fung et al. (2007) identifies elements of the participative efforts and stakeholders, individual consumers or consumer organisations’ inclusion in the process criteria that need to be taken into consideration. These criteria need to be met in order the process itself to be judged acceptable:

• Evidently involve people ‘like me’ in doing so...
• Asking for feedback during the process about what, who, ..., etc information
• Asking before taking the final relevant decisions...
• Follow the process at a pace that allows understanding needs and wants
• Communicating this process, so ‘we all know’...

These can become principles for the process that will identify information provision to be (ad)opted by(in) public government and private institutional actors/stakeholders. It is expected that these will also lead on stakeholders agreement on what to disclose, or allow access to, as a regular course of action and under non-routine circumstances.
**Targeted transparency:** Widespread efforts to increase disclosure for generally increased transparency may not necessarily lead eventually to equally evident results across all contexts. Fostering targeted transparency may be an equally more effective course of social and business actions under certain circumstances (Fung et al., 2007). Actually, the notion of target transparency is seen as a third form of government intervention (Fung et al., 2007), the other two being: government-promulgated standards; and market-based incentives to compel organizations to move in desired directions by means of either subsidies or taxes/trading regimes. Regarding targeted transparency (which uses a broader range of pathways (including behavioural and political ones) to affect the behavior of targeted organizations, but also communication as a regulatory mechanism), there is a need to:

- Assess how identified and disclosed information is actually used by the intended food consumers;
- Develop transparency metrics that suit the purpose for each domain;
- Evaluate if transparency metrics are linked to target policy outcomes in the domains;
- Do 3rd party intermediaries help users understand disclosed info?
- Evaluate incentives/enforcement tools for disclosing information;
- Evaluate how disclosure systems work in tandem with other regulatory tools;

These will also ensure that transparency is both sustainable improving overall public deliberation and a general level of accountability across sectors and over time, but also foster disclosure performance for issues and at points when lack of such performance is perceived to exist. Such points are also what may attract increased attention and become hotly debated, likely grounds for uneven media attention, and grounds for political confrontation. If consumers perceive that there is no issues to (re)act upon, targeted transparency may well indicate that no further information disclosure / use of additional signals is necessary. Participative practices and associated criteria appear to be in line with arguments for best practice in the food risk management and communication literature. For instance, van Kleef et al. (2007) argue that, ‘there has been an increased interest in public participation in risk management decision making as a mechanism to improve confidence in risk management (Frewer et al., 2004; Rowe and Frewer, 2000). However, current knowledge on the effects of public participation on public confidence in risk management is presently unclear, and there is a need for evaluation of how such exercises are conducted and how they impact on policy development (Rowe and Frewer, 2000)’. In fact, lack of performance (and subsequently, lack of public policy performance) may be perceived to exist when the nature, speed and detail of information communicated through adopted disclosure practices are not actually, consumer-centered. This is judged to be (see also Fung et al., 2007) the case when there is:

Perceived lack of value of such information/signals (label/non-label) for consumers’ achieving their goals;

- Information/signals (label/non-label) is incompatible with consumers’ decision-making routines; and
- Information /signals (label/non-label) are incomprehensible.

The above may well be linked to information/signals (label/non-label) being:
- Incomplete (or incomplete in coverage);
- secondary instead of primary (e.g., filtered and distorted);
- in-frequent regarding updates;
- non-timely;
- non-accessible;
- discriminatory;
- proprietary (and thus motivated);
- licensed (thus probably partial);
- at inadequate level of (dis)aggregation;
- non-comparable; but also
- unstandardised

eventually leading to consumer perceived flaws in process or content; in other words not allowing consumers feeling that what they receive (or being able to receive), how and when they receive it allows them ‘light’/‘sight’ to pass through, so that they can distinctly see ‘bodies’ through and easily understand. The ultimate judgement regarding disclosure performance appears to be reached when:

- Information users perceive and understand newly disclosed information/signals and therefore choose (objectively-judged) safer, healthier, or better quality foods;
- Information/signal disclosers perceive and understand consumers’ changed choices that in turn improve their practices, manufactured food products subsequently further reducing risks.

Research in food risk management and communication is in line with the above. For instance, as consumers lack awareness of food safety issues, and they feel they reach a situation of “information overload” in terms of the quantity of risk information they receive, it is the quality, rather than quantity, of risk information that is important (Krystallis et al., 2006). These findings illustrate the importance of finding the balance and a match between information disclosure and the actual consumer needs and concerns. Identification of this delicate balance now appears to be difficult but fundamental; it has also been an evident cause in mishandling past consumer concerns raising initiating transparency requests. Consumer claims that information was often inconsistent, confusing, and difficult to understand was widespread (Van Kleef et al., 2006) and this has contributed to a lack of confidence in the safety of the product (Verbeke, 2005). In the case of BSE, the failure to communicate uncertainty was associated with the decline in public trust of risk regulators (Miles and Frewer, 2003). The above are also in line with Van Kleef et al. (2007: 1576) comment regarding food risk management as transparency may not in itself contribute to increased citizen trust in risk management practices unless what is made transparent in risk management aligns with societal preferences (emphasis added) and also (added) regarding how risk management activities are implemented. Their findings suggest, for example, that proactive risk management activities being developed to mitigate food risks operate as important indicators that the process of risk management meets citizen preferences (emphasis added) for risk management practices.
6 The moderating influence of trust and consumer perception of firm/supply chain motives and willingness to disclose information

Trust has been an area that has attracted substantial attention over the years with multiple contributions alone or in conjunction with other notions (such as confidence) (e.g., Bocker and Hanf, 2000) or risk perception (e.g., Liu et al., 1998; Renn and Rohrmann, 2000; Slovic, 1992; 1999; Viklund, 2003), not only in food but across all economic and social domains (Coulson, 2002; Cowles, 1997; Delhey and Newton, 2002; Earle, 2004; Eiser et al., 2003; Frewer et al., 2003; Frewer and Salter, 2003; Greenberg and Williams, 1999; Hupcey et al., 2001; Jacob and Hellstrom, 2000; Leiss, 1995; Lewicki et al., 1998; Lewis and Weigert, 1985; Lindgreen, 2003; Pennings et al., 2002; Rusbringer, 1999; Siegrist et al., 2001; Weber and Carter, 1998; Wong and Sohal, 2002). As it has been clearly explained in Chryssohoidis et al. (2009), in a range of reviewed research studies, the social phenomenon named “trust” depends upon a number of interrelated aspects. They have posited that related to trust issues can be grouped in the following trust-related factors: (a) information-related characteristics (b) risk-related characteristics (c) institutional characteristics (d) individual socio-cultural and personality characteristics. They identified that:

- The category of trust determined or influenced by the (perceived) characteristics of the information received has been explored in the studies by Slovic (1993); Smith et al. (1999); Cvetkovich et al. (2002); White et al. (2003) and earlier studies by Jungermann et al. (1996) and Peters et al. (1997). All focused predominantly on information content and not amount (except for Peters et al., 1997). Yet, there is a body of literature regarding the effect of amount of risk-related information (e.g. transmitted through media) on the subsequent public judgments of risks and trust. For instance, Frewer and Miles (2002) argues that the increase in the perception of risk of GM foods in the UK could be associated with the intensive reporting on this matter in media.

- Several researchers postulated that public trust in institutions functions differently according to how a particular risk is managed or communicated. Thus, the perception of risk would appear to be a component of trust. However, it has been often referred to as a consequence rather than a determinant of trust, in the sense that, if people trust an institution to manage a specific risk, they perceive the communicated risks as smaller or the benefits as larger. Studies which attempted to explore the effect of perceptions about risks on public trust (or vice versa) include: Siegrist and Cvetkovich (2000); Sjoberg (2001); White et al. (2003); Viklund (2003) and the above mentioned studies by Frewer et al. (1996); Frewer and Miles (2003); Peters et al. (1997); and Maeda and Miyahara (2003).

- Trust determined or influenced by the (perception of) institutional characteristics has been a frequently investigated category. A corresponding objective of the researches has been to detect trust-increasing and trust-destroying features attributable to an institution responsible for risk assessment, management and/or communication. In other words, it has been postulated that attributes such as inter alia “competence”, “knowledge”, “concern”, “openness”, “honesty”, “vested interest” and “fairness” are associated with the level of public trust towards an institution possessing or not these qualities, as assessed by the public. The studies which directed their research efforts to explore this linkage include: Frewer et al. (1996); Frewer and Miles (2003); Jungermann et al. (1996); Peters et al. (1997); Maeda and Miyahara (2003); Hunt and Frewer (2001); Yee and Yeung (2002); and Poortinga and Pidgeon (2003). Van Kleef et al. (2007) argue
that there is evidence that trust in regulators and regulatory institutions may influence risk and benefit perceptions of new technologies and food hazards, such as GM technology in food production (Siegrist, 2000), the use of pesticides in agriculture (Siegrist et al., 2000), the acceptability of food irradiation (Bord and O’Connor, 1990), and other technologies (Miles and Frewer, 2001). Van Kleef et al., (2007) also argue that value similarity is important for attributions of trust of those in charge of managing hazards (Cvetkovich and Löfstedt, 1999); therefore being expected to follow the appropriate guidelines and general principles for setting goals and procedures (Siegrist et al., 2000). Linked to the above (van Kleef et al., 2007) is the notion of trust in information sources (credibility). Source credibility (see also Trumbo and McComas, 2003) refers to people’s perceptions of the motivations of institutions or individuals providing information to the public and it is assumed to be multidimensional and dependent on both information source characteristics and the subject under consideration (Frewer et al., 2003).

- Trust determined or influenced by individual and socio-cultural characteristics of those who exhibit trust has been reported extensively in Earle and Cvetkovich (1997), Greenberg and Williams (1999) and Priest et al. (2003). This category clearly consists of multiple subcategories, each one possibly constituting distinct contexts, ranging from highly individual personality characteristics (e.g., optimism-pessimism, education) to broader socio-cultural features (e.g., one society may have a higher level of social trust in general than another). In the same group, some additional trust-related factors pertaining to individuals’ personalities can be included, such as: “value similarity” (or “shared values”) and “prior attitudes”, the latter also termed “initial trust” or “prior beliefs”. Those contributing to these areas of research include Siegrist et al. (2000), Frewer et al. (2003), Earle (2004), Poortinga and Pidgeon (2003) (also contributing to the group of institutional characteristics), and Cvetkovich et al. (2002) and White et al. (2003) (also focusing on information).

Regarding industry motives, literature on food risk management and communication has long identified a major issue perceived motives of the food chain. Van Kleef et al. (2007) comment that when ‘there is skepticism about industry’s motives, and suspicion that regulators are vulnerable to influence and lobbying, the public is also not (emphasis added) a passive receiver of the views of those that claim to serve the public interest, such as nongovernmental organizations (NGOs) and the media. An analysis of public attitudes to biotechnology in Europe found that NGOs are also seen to have their own “vested interests,” such as in raising funds (Marris, 2001). Van Kleef et al. (2007) continue arguing that these groups are however, perceived positively by the public in that they ask difficult questions of politicians and regulators and raise issues that might not otherwise be brought to public attention. They are therefore seen to have more concern for consumer welfare or the protection of environmental or societal interests than industry and regulators (emphasis added). Including the impact of perceived industry motives is fundamental for perceived transparency. When the content and process of identifying what is necessary for transparency fails to take account of factors that are driving public concern, then the motives of those developing the frameworks appear suspect (Frewer et al., 2004). Lack of inclusion of consumer concerns in the process may well conflict with value systems that dominate public discussion in a particular area, such as genetically modified foods (Grove-White et al., 1997). It has proven a case of widespread systemic failure in the GM discussion the lack of considering the breadth and complexity of public views which has been at odds
with the more circumscribed procedures of scientific risk assessment (Mayer and Stirling, 2004). Consumer questioning on motives may not limit itself regarding food supply chains’ motives alone. People may start to distrust the motivations of regulatory institutions under conditions where consumers perceive regulatory activities to be promoting the interests of industry rather than public welfare (Van Kleef et al., 2007). In the UK, for example, the “GM Nation?” debate revealed a high degree of suspicion regarding the motives, intentions, and behavior of all those making decisions about GM crops and foods (Gaskell, 2004; Horlick-Jones et al., 2006’). Furthermore, consumer perceptions regarding excessiveness of nuts’ precautionary labeling ..‘may contain’..) as a potential food allergen is seen only to serve industry’s interests by offering protection against litigation (Cornelisse-Vermaat et al., 2009); it can also be considered as inadequate information disclosure.

7 Barriers of transparency

Nonetheless, there may be difficulties and barriers for transparency. Fung et al. (2007) argue that barriers will exist when:

- The information/signal gap is not bridgeable / does not contribute substantially to public risks or perceived system failures; also (counter)action plan is simply undoable;
- The (food-related or associated) problem does not lend itself to measurement and there is lack of consensus on measurement;
- Communication is impractical (too multifaceted and complex);
- Consumers do not have the will (or give value to issues), capacity and cognitive tools to inform their food choices;
- Performance cannot be feasibly improved or risks be feasibly reduced;
- Variability and uncertainty are not acceptable;

Additional barriers may also exist, namely:

- There is a lack of overview of practices of chain members beyond their own activites; thus organisation for greater transparency is actually difficult
- There will be fear of disclosing confidential information to competitors, and retailers despite goodwill intentions;
- There is currently a widespread underestimation of consumers’ interest and there is no widespread alertness in food supply chains for fuller disclosure;
- There is fear of being challenged by clients, and consumers;
- There is a wider confusion regarding traceability, leading to think that those who have traceability system do not have to do any other efforts,
- There is an apparent lack of understanding for the need to fully verify statements made and to make these available for consumers;
- When bulk goods are handled and the unit of traceability changes there are technical difficulties to specify the unit for which statements cane be made;
- Signals from certicates are mostly based on trust in the certification body, consumers do not have an access to additional information;
- Information already disclosed exists, but the users, consumers (segments) have (not) been made aware of it;
• Lack of knowledge of available solutions, their capability, use, cost implications (overestimating costs) also exists;
• Poor communication skills among the chain actors/stakeholders are evident;
• Complexity of the problem/difficulty to explain is evident despite advanced communication tools

8 Interfacing with information transmission standards, technologies and information carriers

Much of information and disclosure of such information to consumers discussed above (and contained in table 1) can transmitted throughout the food supply chains with what is termed, although not exclusively, as ‘traceability’ systems. Such systems can be probably considered as an overarching set of activities and information flows that allow identification of further details about the provenance of a food and other elements, thus allowing identifications of details about its composition, production process and other elements (see for instance issues described in Table 1). The reasons for the development of such systems may have been threefold. As indicated in Bente and Holmbl (2006), concerns were risen following the BSE crisis that prompted the introduction of a system to track cattle. Also, the subsequent establishment of the US Bioterrorism Act obliged traceability for any food reaching US borders; similar developments took place in Europe. Third, the growing power of retailers has enabled integrated food chain systems to develop in a way that mirrors changes in European regulatory ‘from farm to fork’ frameworks, including HACCP. Related developments included the introduction of a number of best practices, such as BRC (British retail Consortium) Global Standard Food whose scope covers many areas of product safety and legality and due diligence requirements (taking all reasonable precautions to avoid safety problems). These have inherent traceability practices integrated in business processes. It is suggested that the existence of traceability systems underpin the efforts for transparency. For instance, Miles et al. (2005) found that labeling for GM foods was not perceived as effective by consumers unless there was an effective traceability system supporting the purpose. While labeling enables consumers to make an informed choice under conditions where they otherwise lack personal control over exposure, consumer perception of scientific and regulatory inability to trace GM foods reduces public confidence in food safety (Frewer et al., 2004; Frewer and Miles, 2002). Traceability systems support scientific and regulatory capacity to remain informed and intervene. Furthermore, consumers indicated increasing willingness to pay when labeling of beef and pork was coupled with traceability information as this act as credibility signals, especially if linked to quality assurance; ultimately maintaining consumer confidence in the industry (Hobbs et al., 2005). Lat, but not least, and as also commented by Chrysochou et al. (2009) voluntary and mandatory labeling information expands mainly as a result of widening traceability requirements by legislation and consumer preference (Cheftel, 2005), so does the information to be recorded, transmitted and stored for further use (Ayalew et al., 2006).

In combination with new trends in food packaging technology, there has also been a boost in the use of technologies that can store and carry product information (e.g., Ahvenainen, 2003; Bech-Larsen, 1996; Eastlack et al., 1993; Hutton, 2003; Kerry et al., 2006), although technologies as such may fail to gain consumer acceptance (e.g., Cantwell, 2002; Fox et al., 2002) or have varying degree of perceived utility (Cardello et al., 2007; Lähteenmäki and Arvola, 2003). Current and most frequently used information carriers are the linear barcodes. Two are the main actors that set the standards for open codes named European Article Numbering (EAN) and Uniform Code Council.
(UCC). A common global standard did not exist until UCC and EAN affiliated forming the GS1 (formerly EAN.UCC) system, which covers global e-business communications standards, numbering schemes, uniqueness management, and bar code symbology standards, including the Universal Product Code (UPC) and EAN bar code symbols used on consumer goods around the world (Bechini et al., 2008; GS1, 2007). Specific examples on the retail/industry front concern efforts to establish and get widely accepted standard for food information transmission exist. For instance, for food traceability information see e.g. TraceCore XML at http://www.tracefood.org/index.php/FAQ, for describing food composition see http://www.eurofir.org/eurofir/CENStandard.asp. Moreover, issues regard practical applicability. GS1 (http://www.gs1.org/) attempt to extend their basic food and beverages standard to include traceability information; open standards information organisations also look at the issue (http://www.oasis-open.org/home/index.php).

Furthermore, with respect to carriers of information and problems of implementing/ interface standards, one of the most recent technologies is radio frequency identification (RFID) tags (e.g., Curtin et al., 2007; Juels, 2006; Kärkkäinen, 2003). Challenges of their implementation in the food supply chain are well reported in the literature (Bottani and Rizzi, 2008; Günther and Spiekermann, 2005; Jones et al., 2005; Kelepouris et al., 2007; Regattieri et al., 2007; Sarma et al., 2002; Sellitto et al., 2007; Theissee, 2006; Weinberg, 2005). Originally viewed as essentially remotely-readable bar codes, RFID tags have been available for many years. However, only the last decade RFID technology gained widespread public attention when retailers such as UK’s Marks and Spenser, Germany’s Metro Group and USA’s Wal-Mart began experimenting with RFID tags embedded in individual consumer products (Juban and Wyld, 2004; Loebbecke, 2005; Phillips et al., 2005). Empirical estimations want RFID technology rise dramatically the last decade along the food supply chain (IDTechEx, 2007). As a proof for their importance recent developments want Wal-Mart to require its suppliers to use RFID (Jones et al., 2005; Kelly and Erickson, 2005), whereas Metro Group to gear up RFID use in all of their stores with equipped RFID portals. Chrysochou et al. (2009) identify other traceability systems which are less common and still under development in the food industry. These involve: edible marking systems, DNA based technologies and e-paper tags. Edible marking systems are natural light technologies that use a laser to etch identifying information on edible products such as fruits and vegetables, and have been proposed as an alternative to adhesive labels (example are Durant-Wayland- see www.durand-wayland.com; and DataLase - see www.datalase.com). DNA based technologies are used primarily for identification of livestock and fish, and in the detection of genetically modified organisms (GMOs) (Loftus, 2005). DNA systems are rather aiming at food identification than storing traceability information thus can be incorporated with other systems such as RFID. E-paper tags are electronic paper displays designed to mimic the appearance of regular ink on paper (currently used in e-book readers, newspapers and cell phone displays, whereas recent applications in food labeling and substitute of RFID tags are believed to boost their use). All above carriers however face substantial problems as they are confronted with multiple types of information/signals that need to be carried forward by a single information carrier; furthermore, they have limited space available for storing information (like an RFID or electronic labelling system) as they need to include all at the same time for complete information transmission the following:

- traceability information/signals as these relate to logistics (supplier, buyer, transport details);
• traceability information/signals as these relate to authenticity and fraud avoidance (securing that the ingredients and production methods are the ones claimed to be);
• traceability information/signals as these relate to geographical origin for PDO/PGI/TSG,
• traceability information/signals as these relate to production process (e.g., organics, special feed),
• traceability information/signals as these relate to satisfaction of environmental standards or trade (e.g. fair trade),
• nutritional composition (e.g. with minimal use of trans-fatty acids, sugar substitutes etc);
• composition in terms of ingredients that may cause health problems to specific groups such as food allergy sufferers.

There is lack at present of suitable RFID and barcode technology or other on-the-product technology that can carry the above structured information (see eg http://www.chill-on.com/) which at the same time minimises implementability issues (breaks of information-chains) of information that may be required by consumers.
# IV BEST PRACTICE

Prepared by:

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34 Earlier version published as deliverable within the EU project Transparent_Food: D6.2 Analysis of selected experiences of ‘best practice transparency solutions’ in enterprises and food chains
ABSTRACT

Transparency is one of the most complex and fuzzy issues the food sector is facing. It is widely acknowledged that an appropriate transparency is of crucial importance and a critical success factor for 1) guaranteeing food safety and quality 2) sustainable development 3) providing consumers with information to support their buying behaviour and 4) identifying a suitable regulatory environment. Given the economic (e.g. employment, added value), ecological (e.g. food miles) and ethical (e.g. animal welfare, fair trade) importance of the agri-food business, the urgent need to prepare an inventory of good practices and experiences regarding transparency was identified (EC 2009). Consequently, within the TRANSPARENT_FOOD project a good practice inventory regarding transparency in food value chains was compiled. Practices were gathered worldwide and were critically evaluated for patterns which can help to find out what makes a transparency case a success story. Subsequently, practice (good practice inventory) and theory (scientific literature) were critically matched to identify gaps. Results indicate that a number of experiences exist which are effective in addressing transparency issues. However, questions remain regarding more specific characteristics of how transparency systems can be best implemented/improved.

4.1. Introduction

The good practice chapter is based on the Work Package 6 “Best Practice and Performance” of the TRANSPARENT_FOOD project, which deals with the identification and analysis of good practices regarding transparency in food value chains. The objective was to compile an inventory, which provides hard evidence related to the benefits of transparency.

Given the economic (e.g. employment, added value), ecological (e.g. food miles) and ethical (e.g. animal welfare, fair trade) importance of the agri-food business, one of the objectives of the Transparent Food project was to compile a good practice inventory regarding food chain transparency and to analyze selected good practices in-depth to (1) help making the concept of transparency more understandable, (2) provide useful examples from different transparency domains (e.g. food safety, food sustainability etc.), (3) illustrate the difficulties of transparency, (4) provide good practice experiences that have proven themselves over time to reach transparency in the food chain, (5) provide good practice experiences where the optimal level of transparency can be delivered more effectively with fewer problems and unforeseen complications, (6) provide useful examples to improve the average performance of existing transparency systems, and (7) provide useful examples for all stakeholders within the food chain to develop new transparency systems.

Transparency is one of the most popular concepts within chain management in general and within food chain management in particular. However, researchers as well as practitioners often raise the question of whether the more transparency the better. To answer this question, one needs to analyze good practice experiences regarding food chain transparency. Therefore, within the TRANSPARENT_FOOD project good practice inventory was created, where worldwide good transparency practices were gathered. Subsequently, the most interesting good practices which go beyond usual practices were selected and further analyzed. Hereby, the focus was on transparency needs of consumers, industry and policy towards food safety, food quality, food integrity, economic issues and transparency enabling technologies.
The chapter is structured as follows. First, methodology used for identifying and analyzing the good practices is described. Second, food transparency domains and sub-domains are elaborated. Third, selected good transparency practices are presented and listed, and finally a conclusion is formulated.

Acknowledgment
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4.2. Methodology
This chapter is based on the methodology for identifying good transparency practices developed in WP 6 of TRANSPARENT_FOOD project. The good practices are investigated with emphasis on food safety, food quality, chain integrity, economic issues and enabling technologies for food transparency. The objective was to compile an inventory, which provides hard evidence related to the benefits of transparency. To complete this goal, following tasks needed to be fulfilled. First, good practices regarding transparency in food value chains are identified. For the selection of these good practices, a template was prepared. In total, 72 good practices were identified, which created a good practice inventory. The second task included the organization of a workshop with the working group members of WP6 for selecting the good practices from the good practice inventory. In total, 21 good practices were selected. Afterwards, eight selected good practices were analyzed and documented based on an in-depth template.

In this chapter, the aim is to present different good practices across different transparency domains instead of focusing on detailed description of a few good practice. In line with this, focus is not on the results from the in-depth analysis, but instead of that the lessons learned. Therefore, each presented good practice is described in terms of results from the template for identification of good practices (Figure 1) and the template for identification of good practices going beyond usual practice. The template for identification of good practices contains general aspects regarding transparency practice, namely transparency problem, solution, tangible results achieved and potential benefits and/or weaknesses (Figure 1).

Figure 1: Template for identification of good practices
On the other hand, template for identification of good practices going beyond usual practice investigated more specific aspects of good transparency practices, such as: What is communicated to the other businesses and to consumers? How is it communicated? What is the good practice in this example? What makes the good practice unique? What goes beyond usual practices? How do they make transparency work? What is the part that can be recommended in non-similar cases for use by others?

4.3. Transparency domains
The analysis of the good practice inventory indicates that food chain transparency can relate to five different domains, namely safety, quality, integrity, economic issues and enabling technologies for transparency. Each domain can be further divided into different sub-domains (Table 1).
Within the domain of food safety, a distinction can be made between compositional, technological and organizational aspects. Compositional aspects relate to transparency of chemical hazards (e.g. heavy metals, pesticides, nitrates), biological hazards (e.g. microbiological pathogens, toxins, allergens) and analytical considerations (e.g. official accreditation by ISO standards). Technological aspects focus more on the manufacturing of food products: transparency of the primary production (e.g. GM vs. GM free), processing (e.g. traditional vs. emerging technologies), packaging (e.g. intelligent packaging), transport and distribution (e.g. temperature control), handling (e.g. intended use) and abuse (e.g. sabotage). Organizational aspects include legal (e.g. HACCP) and voluntary (e.g. BRC) management systems for food safety. Also monitoring schemes, such as official food surveillance, are categorized into this sub-domain.
The domain of food quality can be divided into eight sub-domains: (1) composition, (2) health and nutrition claims, (3) sensory properties, (4) raw material production, (5) storage conditions, (6) processing methods, (7) packaging and distribution and (8) authenticity. In contrast to the compositional aspects of food safety, the sub-domain composition of food quality refers to transparency of enriched products, reduced ingredients and microbiological quality.
The third domain, food integrity, comprises three sub-domains representing origin, environmental issues, ethical and social issues. The sub-domain of origin relates to transparency of place, region and country. Consequently PDO (Protected Designation of Origin) and PGI (Protected Geographical indication) can also be categorized into this domain. Environmental issues can be for example organic production processes, integrated farm management and carbon footprint labeling. Ethical and social issues, on the contrary, relate to transparency regarding animal welfare, labor and working conditions, fair trade, social and community capital, and vegetarian production processes.
The fourth domain, economic issues, focus on price transparency, cost transparency, profit transparency etc. Finally, the fifth domain comprises enabling technologies for transparency.

Table 1: Overview of the transparency domains and its sub-domains

<table>
<thead>
<tr>
<th>Domain</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Food safety</td>
<td>Animal health, animal identification, traceability, hygiene, etc.</td>
</tr>
</tbody>
</table>
| 1.1. Compositional aspects | – Chemical hazards  
|                  | – Biological hazards  
|                  | – Analytical consideration |
| 1.2. Technological aspects | – Primary production  
|                      | – Processing |
4.4. Good Practices

In this section some general insights are presented into good practices and further selected good transparency practices, are individually presented which goes beyond usual practice. Results indicate that a number of experiences exists which are effective in addressing transparency issues. Successful practices in communication of information include:

- Sharing information with customers on specific lots (via lot codes) through
  - web-based systems;
  - detailed documents;
- Sharing information with consumers on specific lots, they had purchased through web-based systems via lot codes on retail packaging;
- Traceability information on
  - chain members involved in the supply;
  - their practices and products;
  - by descriptions, videos, photographs, virtual and real tools in their sites;
  - information on the location of their sites, origin of ingredients.
- Using codes (instead of real names) of chain members ensured confidentiality.

- Further good practice examples include:
  - “Open days” of agricultural and food processing plants.
  - Understandable explanation of the different transport documents for consumers.
• Provision of indicators, benchmarking and self-assessment tools showing information on advantages and disadvantages of products and system to support informed decision making (e.g. TetraPak carbon footprint calculator, toolboxes).
• Collective website for SMEs for sharing information in order to improve transparency.

On the other side, some typical challenges concerning transparency solutions are detected as well. The most often ones are:
• The concepts of traceability and transparency are often mixed.
• Statements/claims are not verified or the information on verification is not accessible.
• Certification schemes are rather judged depending on the trust in the certification body, no access to information about the certified company.
• Access to transparency information requires active searching, and the information found is easily understandable.

• Good practice examples of improving accessibility of information:
  • The extent of transparency is influenced by the level of accessibility to the details of information which support the credibility of statements and claims. The level of accessibility ranges from fully open access to the details of the performance and criteria on which statements are based till the situation, when no, or very limited information is available. There is a difference in accessibility of information, where the information provider is building a claim or statement on a single or a few simple criteria, which can be understood easily by the consumer and the complex system of several criteria, where the assessment can be made only by professional evaluators.
  • For consumer accessibility the following solutions can be applied, representing a decreasing level of openness:
    • Provision of opportunity of a personal visit and/or a visual observation about the farm environment and animal breeding conditions on farms, through open gate events or through web-camera, on the factory environment and food processing conditions through guided tours, on site presentations, and virtual tours at food manufacturers, presenting the actual preparation of the products supplied to the consumer through web-camera (like at pizza);
    • Provision of written information, which can be interpreted by basic knowledge, such as list of ingredients on labels, short simple description of the manufacturing process, the selection of the ingredients, the monitoring and approval schemes, provision of information on the traceability, route of information, what the consumer purchased. Here through the use of codes replacing the name of the supplier can ensure the protection of the confidential information.
    • Provision of information for which expert knowledge is required for interpretation - time-temperature data.
    • Short, easily understandable explanation of the requirements for which expert knowledge is necessary for the interpretation, such as the basis of health claims.
    • Provision of indicators such as the GDA, carbon footprint, etc.
Short, easily understandable explanation of the requirements of standards on which transparency signals are based.

At certification schemes the different levels of accessibility include:

- Open access to both criteria and assessment of performance. It is not realistic to provide this information to consumers and it is usually not necessary for them, since their trust is based mostly on the credibility of the certification companies. This approach is frequently used in B2B transparency communication. The criteria of the systems are available openly free of charge or by purchasing the standard. The audit results can be made accessible by provision of an access code to the report by the supplier to the customer or through sending the report to customers for whom the suppliers wants to make them accessible.

- Disclosing the level of compliance to consumers or customers and open access to the criteria of the standard by purchasing the standard. This information is usually accessible for businesses without restriction.

- Access to the criteria of the standard freely or by purchasing the standard and provision of a general explanation of the main principles on which the detailed assessment criteria are based. This solution is typical for environmental audit and certification schemes, schemes on ethical and social values and food safety and quality management certification schemes.

- No information is available except the fact, that the food business supplying the food achieved compliance to the criteria of the standard. This may be indicated by a logo and/or a certificate. In some cases a list of certified companies is maintained and is made publicly accessible by the system owner.

- No information is available.

Good practices which are individually presented are listed in the Table 2. They are chosen with intention to represent each transparency domain described in the section above. Moreover, it was important that good practice goes beyond usual transparency practices and can be applied for further development of existing systems or new systems with superior performance. Table 2 gives an overview of the selected good practices with respect to transparency domains (see section 1.2.).

Table 1: Selected good practices which go beyond usual practices

<table>
<thead>
<tr>
<th>1. Food Safety</th>
<th>2. Food Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Compositional</td>
<td>2.1 Composition</td>
</tr>
<tr>
<td><em>Detection of antibiotics in milk</em></td>
<td><em>Frosta</em></td>
</tr>
<tr>
<td><em>Red Lobster</em></td>
<td></td>
</tr>
<tr>
<td>1.2 Technological</td>
<td>2.2 Health and nutrition claims</td>
</tr>
<tr>
<td><em>Identity preserved soy</em></td>
<td><em>Food Standard Agency “Eat Well Campaign”</em></td>
</tr>
<tr>
<td>1.3 Organization and discipline</td>
<td>2.3 Sensory properties – handling</td>
</tr>
<tr>
<td><em>Red tractor</em></td>
<td><em>Domino’s Pizza</em></td>
</tr>
<tr>
<td>1.4 Raw material production (e.g. cultivar based, quality categories, genetic modifications)</td>
<td>2.4 Raw material production (e.g. cultivar based, quality categories, genetic modifications)</td>
</tr>
<tr>
<td><em>Matured beef</em></td>
<td><em>Matured beef</em></td>
</tr>
<tr>
<td>2.5 Storage conditions (e.g. temperature monitoring)</td>
<td>*RFID for monitoring storage conditions</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>2.6 Food processing methods (e.g. traditional vs. emerging technologies)</td>
<td>*Plukon Royale Group</td>
</tr>
<tr>
<td>2.7 Food packaging and distribution (e.g. active and intelligent packaging, other than safety aspects, product-packaging interactions)</td>
<td>*Smart packaging</td>
</tr>
<tr>
<td>2.7 Authenticity</td>
<td>*Quality of AOC wines</td>
</tr>
<tr>
<td>3. Food Integrity</td>
<td></td>
</tr>
<tr>
<td>3.1 Origin (referring to place, region and country) (Including PDOs and PGIs).</td>
<td>*Gut so!</td>
</tr>
<tr>
<td>3.2 Environment</td>
<td>*Climate labelling for food</td>
</tr>
<tr>
<td>3.3 Ethical and Social</td>
<td>*CareTrace</td>
</tr>
<tr>
<td></td>
<td>*Marine Stewardship Council</td>
</tr>
<tr>
<td></td>
<td>*Frilandsgris free range pigs</td>
</tr>
<tr>
<td>4. Economic issues</td>
<td>*European Food Prices Monitoring Tool</td>
</tr>
<tr>
<td>5. Enabling technologies for transparency</td>
<td>*Electronic product code</td>
</tr>
</tbody>
</table>

As mentioned in the methodology section, each presented good practice is described in terms of results from the template for identification of good practices (Figure 1) – general aspects – and the template for identification of good practices going beyond usual practice, thus specific aspects.

4.4.1. Detection of antibiotics in milk (Henry Jäger, TUB)

General aspects

1. What is the transparency problem?
The application of antibiotics for dairy cows is undesirable but sometimes unavoidable. Contamination of milk presents a health risk for the consumer and leads to major technological problems during milk processing. Currently undertaken controls in the dairy factory require time and in the case of rapid tests, they do not allow an identification and quantification of the particular substance.

2. What is the good practice solution?
A control system for residual antibiotics in milk consisting of a biosensor array was developed in order to allow a simple and fast identification of a large number of antibiotics at an early stage of milk production (on farm or immediately after milk delivery to the dairy factory). Key component of the system is a microarray chip using an antigen-antibody reaction for the identification and quantification of up to 13 antibiotics in less than 6 minutes.

3. What are the benefits and weaknesses from the main stakeholder point of view?
The system provides a rapid, cost effective and reliable method for the detection of antibiotics in milk and closes an analytical gap. It helps to ensure food quality and safety by revealing possible health risks for the consumer. It contributes to the minimization of product losses by the detection of antibiotics at an early stage of milk processing.

4. What is the tangible result?
An introduction of the system into the milk production as well as the dairy industry sector is currently undertaken.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**
In this case, no communication to the consumer is taking place. It needs to be guaranteed, that high quality antibiotic free milk products are provided and the consumer is relying on this. Communication takes place at an earlier stage in the production chain between the dairy farm and the dairy company. Milk samples are collected and analyzed. There is a feedback on results from the dairy factory to the farmer which helps to improve his manufacturing practice and is the basis for milk payment. Communication takes place backwards along the food chain.

6. **What is the good practice in this example? What makes the good practice unique? What goes beyond usual practices? How do they make transparency work?**
Milk collection takes place at several farms. Smaller amounts of milk are mixed and transported to the dairy company. There, the road tanker is unloaded and several road tanker loads are mixed again in a large container. The earlier the occurrence of antibiotics in small amounts of milk can be identified, the lower the product losses are. Furthermore, if antibiotic residues can be traced back to one single farmer, consequences can be communicated directly and result in improved production processes. Having this biosensor as a simple and fast analytical method, identification and elimination of contaminated samples are facilitated.

7. **What is the part that can be recommended in non similar cases?**
There are two basic principles that apply in this case and can be also applied to non-similar cases: It is the elimination of critical raw materials or products at the earliest possible stage in the production chain and the availability of analytical methods for their identification.

(Research Association of the German Food Industry)

4.3.2. **Red lobster** (Attila Berczeli, CCH)

**General aspects**

1. **What is the transparency problem?**
Allergies to foods have become a big issue for restaurants. More than 12 million Americans have allergies to ingredients such as wheat, soy, eggs and dairy according to the Food Allergy & Anaphylaxis Network. Though not technically a food allergy, celiac disease (an intolerance to gluten) has been an issue as well. In the EU there is obvious regulation for handling the allergens in the food industry. However the foods in the restaurants without packaging and labeling is a problem.

2. **What is the good practice solution?**
Red Lobster has started to give some diners with more information about potential food safety hazard in their food. The chain, owned by Darden Restaurants in Orlando (US), has begun testing a menu that lists major allergens such as dairy products, wheat, peanuts, eggs and different types of seafood in its dishes. After recently disclosing nutritional information for every item on all of their menus, the allergen menu is a natural next step in their commitment to transparency.
At Red Lobster in Sanford, diners with food allergies can get a printed-out chart that notes the major allergens in its dishes. The information also points out items at risk for cross-contamination through frying or grilling.

There are some other company who have already taken similar steps. Other restaurants provide varying degrees of information. Sonny's Real Pit Bar-B-Q, based in Maitland, provides a list of foods with major allergens online and has printed information for guests in restaurants. Panera Bread has offered booklets of printed allergen information and of all ingredients for menu items in its stores.

3. What are the benefits and weaknesses from the main stakeholder point of view?
Darden did not answer specific questions about the menu, which is not in all Red Lobster restaurants. The company would not say whether other chains are testing it but said it plans to offer the menu at more restaurants.

Allergen information is not available on its websites. Diners must rely on asking restaurant staff or on contacting the chains' guest-relations departments. Customers can get a full list of ingredients through guest relations, but those departments have limited hours and it can take several hours or even until the next day to get the information.

4. What is the tangible result?
Lists of major allergens in restaurants are becoming more mainstream, this is actually the direction that most restaurants will be going in. The guests have benefited from access to information about what's on their menu.

Specific aspects

5. What is the message? What is communicated to the other businesses and to consumers? How is communicated through the chain?

The allergens in food can be seen as food safety hazards, also in restaurants. However, when you eat anything from the cart of Red Lobster, they will inform you what materials are in the dishes.

6. How do they make transparency work? How do they visualize the message/information?

This restaurant chain has printed only special carts. However other chains have started to provide a list of foods with major allergens online and have printed information for guests in restaurants. Additionally they have offered booklets of printed allergen information and of all ingredients for menu items in its stores.

7. What are the technical devices/means do they use for the visualization?

They have printed special carts for their guests. Allergen information is not available on its website.

Reference: By Sandra Pedicini, ORLANDO SENTINEL
10:41 p.m. EDT, July 8, 2010

4.3.3. Identity preserved soy (Andras Sebok, CCH)

General Aspects

1. What is the transparency problem?

Today the majority of soybean grown is genetically modified. During the production, handling, storage, transport and processing there is a high risk that GMO free soybeans and the products made
thereof are cross-contaminated with GMO containing soy. In Europe there are major consumer concerns about the food safety, sustainability and ethical issues related to GMO food and feed. There is a significant consumer demand for GMO free products. Food products which are made of GMO, or contain an amount of GMO from inadvertent use over a threshold or made of raw materials or ingredients having known GMO content must be labeled. As a consequence of the consumer concerns the major retailers and other buying organizations usually reject GMO containing products. Cross-contamination of solid ingredients and products can’t be reliably detected by finished product testing. Processing reduces the detectability of GMO. GMO free soy products usually get a price premium. There is a need for a system of control measures along the whole soy bean product chain to ensure the GMO free status and to provide evidences that appropriate segregation practices were followed during production, handling, storage transport and processing.

2. What is the good practice solution?
The identity preservation systems for grains consist of a set of measures controlling the production, harvesting, handling, storage, transport including containerization and processing in such a way that the specific characteristics, traits and value of a crop desirable for specific end users are preserved by careful and effective segregation from other lots which do not have the same traits and values. Detailed full chain traceability records are attached to the product lots providing additional information on validity of the supplier warranty declaration on GMO free status.

3. What are the benefits and weaknesses from the main stakeholder point of view?
The main benefit is that detailed and more reliable information covering the full chain is provided to the end users and final buyers, who can provide this information to the consumers by request. The third party verification provides additional warranty. Food processors can reduce the risk of processing limitedly marketable products caused by unknown, not declared GMO content. Growers and traders get a price bonus for their extra efforts.

There is a major technical weakness since the system and the current practices are not able to prevent cross pollination, inadvertent cross contamination fully. Sampling and finished product testing methods have limited reliability and testing is expensive. No one can claim full GMO free status; rather the efforts can be proven. Further research is necessary to determine the minimum achievable threshold.

4. What is the tangible result?
There is a system based on the combined used of traceability, segregation, record keeping and third party verification which provides some verification on the validity of the statements on GMO free status and a better verification of the efforts made to achieve that.

Specific aspects

5. What is communicated to the other businesses and to consumers? How is it communicated?
Food products which are made of GMO or which contain an amount of GMO from inadvertent use over a threshold or made of raw materials or ingredients having known GMO content must be
labeled. There is a high risk that GMO free soybeans and the products made thereof are cross-contaminated with GMO containing soy.

6. What is the good practice in this example? What makes the good practice unique? What goes beyond usual practices? How do they make transparency work?

The system starts at the specification of required growing and harvesting practices and includes clear purchasing specifications, application of segregation zones at harvesting, cleaning of machinery (planters, combines, trucks, wagons, augers, storage bins, etc) with GMO free materials at change over after GMO containing materials. The buyer may require a legal right to visit the production, operation site of the supplier at any time. This is combined with detailed record keeping along all steps of the chain together with laboratory testing at several stages. Third party verification is also applied. The supplier makes a warranty declaration for the specific properties, characteristics of each lot. Detailed and more reliable information covering the full chain is provided to the end users and final buyers, who can provide this information to the consumers by request. The third party verification provides additional warranty.

7. What is the part that can be recommended in non similar cases?

There is a system based on the combined use of traceability, segregation, record keeping and third party verification which provides some verification on the validity of the statements on GMO free status and a better verification of the efforts made to achieve that.


4.3.4. Red tractor (Katrien Van Lembergen, Adrienn Molnar, UGent)

General aspects

1. What is the transparency problem?

Due to the incidence of the mad cow disease (BSE) in 1996, the UK faced a food crisis that resulted in a decline of consumers’ trust in food. Around that time the public also faced a profusion of food standards and labels.

2. What is the good practice solution?

Assured Food Standards (AFS) was established in the spring of 2000. This independent organization helped harmonizing the approach of standard setting and inspection throughout the supply chain. In addition AFS developed the independent quality mark ‘Red Tractor’ to assure safe and affordable food that can be trusted and easily recognized. Red Tractor guarantees that the food comes from farms and food companies that meet high standards of food safety and hygiene, animal welfare and environmental protection.

The Red Tractor plays a major role in the future of food and farming. It has to promote the recognition of professionally produced assured food. Moreover, the label has to boost the reputation of food production in the UK. First production standards are established, second regular inspections are carried out to ensure that producers, processors and other operators meet those standards.

3. What are the benefits and weaknesses from the main stakeholder point of view?
Food, provided with the Red Tractor mark, comes from an assured production chain in which all producers, processors and packers meet the standards. This good practice ensures better communication throughout the supply chain, integrates quality management and food safety management, reduces food safety hazards and brings transparency throughout the food supply chain.

4. **What is the tangible result?**
This easily recognizable symbol stands out in a busy shopping environment and provides reassurance that the food has been produced according to independently inspected standards. The Union flag in the Red Tractor logo offers an independently verified consumer guarantee that the product has come from a UK farm.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**
A lot of farm products are sold as ‘primary’ foods, while others are sold as a mixture of ingredients. The Red Tractor mark tells consumers that the main ingredient in these food mixtures is assured and it also indicates the origin of these food mixtures.

The quality mark, Red Tractor, guarantees that the food comes from UK farms and from food companies that meet high standards of food safety and hygiene, animal welfare and environmental protection.

6. **What makes the good practice unique? What goes beyond usual practices? How do they make transparency work?**
Inspection is carried out throughout the supply chain, to ensure that producers, processors and operators meet the standards. Consequently, food provided with the Red Tractor mark, comes from an assured production chain.

The main criteria that have to be fulfilled:

1) The main ingredient being promoted must be named.
2) It must come from the usual assured chain.
3) It must be at least 65% of the total product.
4) All of the named main ingredient must be assured. Even if, for example, 65% of the beef in a beef burger is assured, the product cannot contain any additional beef from another source as the entire named ingredient must be assured.
5) The Union flag in the Red Tractor logo on these foods is the consumer’s guarantee that the product is wholly British

7. **What is the part that can be recommended in non similar cases?**
The system is based on licensing agreements from Assured Food Standards (companies only use the logo on food that is eligible to carry it, companies keep production records that will prove this, etc.), independent inspection (which makes it possible to trace all Red Tractor products to their farms of origin) and traceability.

For more information: [www.redtractor.org.uk](http://www.redtractor.org.uk)
4.3.5. **Frosta** (Attila Berczeli, CCH)

**General aspects**

1. **What is the transparency problem?**
   With consumers being far more informed than they have ever been on healthy options, they are getting increasingly concerned about what they are eating. The healthy trend is progressively growing and has moved from being just a fad to a way of life. There is a trend that consumers are getting far more health conscious. Frosta decided to remove all additives from its products and fully labeling every ingredient on the packaging, it broke new grounds and became Germany’s first producer to introduce additive-free frozen ready-meals. The key element of Frosta’s product portfolio is that all products are free of taste enhancers, colorings, stabilizers and emulsifiers. The ingredients are all fresh produce with as little technological processing as possible. The transparency problem was to demonstrate these properties for the growing number of costumers and consumers who talking to them about taste-enhancers and allergies.

2. **What is the good practice solution?**
   Alongside additive-free production and clear packaging, Frosta emphasizes clear ingredient listings on packages. The back of every one of Frosta product is a transparent declaration of the ingredients. They always declare the details, with specific explanations about where they came from. For example, the beef in the company’s Gulasch Pan is from South American cattle that graze outside, without human feeding.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**
   It strengthens the reputation and credibility with consumers and with other business partners.

4. **What is the tangible result?**
   In the light of the current economic crisis, consumers are less likely to eat out, which in turn spells a growing demand for good quality, clean food. Overall, the frozen food market is growing though in different percentages in different countries but more so in the UK and Europe. Over the last three years, Frosta has experienced a 12 percent growth year on year. The company was able to differentiate themselves from the competition.

**Specific aspects**

5. **What is the message? What is communicated to the other businesses and to consumers? How is communicated through the chain?**
   “Our frozen food products are healthy.” Frosta has removed all additives from their products. The ingredients are all fresh produced with as little technological processing as possible.

6. **What are the company doing for achieving transparency (base)?**
   Frosta demonstrated above mentioned properties for the customers and consumers, which talking to them about taste-enhancers and allergies, on the packaging material and different surface of media and internet. Frosta emphasizes clear ingredient listings on packages. They always declare the details, with specific explanations about where they came from.
7. **How do they make transparency work? How do they visualize the message/information?**
Every ingredient is fully labelled on the packaging of the product.

8. **What are the technical devices/means do they use for the visualization?**
Information on packaging material. Advertisement on the internet and other media. Website information for consumers.

Resource: Igls Forum 2009
For more information: [http://www.frosta.com](http://www.frosta.com)

4.3.6. **Food Standard Agency “Eat Well Campaign” (Donna Simpson, City)**

**General aspects**

1. **What is the transparency problem?**
Research carried out by the Food Standards Agency in 1997 revealed that the public wanted more information and guidance on recommended foods for a healthy diet. In addition, the Agency sought to raise public awareness about the effects and benefits offered by an increased consumption of fruit, vegetables and fiber and to encourage people to eat more fruits and vegetables.

2. **What is the good practice solution?**
The Food Standards Agency developed and implemented the ‘Eat Well, Be Well’ food campaign. The campaign sought to raise awareness of the benefits of eating fresh fruits and vegetables. One approach was to base the campaign around a simple message which advised that individuals should aim to eat five portions of fruit and vegetables every day. In addition, information on what constitutes a portion was provided. TV advertisements, leaflets and posters were the prime methods of information delivery for the campaign.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**
Greater awareness of the health benefits of eating fresh fruit and vegetables was a benefit for both consumers and for the Food Standards Agency who initiated and led the successful campaign. A weakness of the campaign was that its message was limited to recommending fresh fruits and vegetables and did not, for example, cite specific foods that are high in fat, sugars and salt to avoid.

4. **What is the tangible result?**
The Eat Well Campaign has broadened its focus and the current website provides information and advice on a range of health and dietary issues. These include the ‘eatwell plate’ which seeks to help individuals understand the correct portions and types of food to enable a healthy and balanced diet. Tips are also provided for eating well at different ages and stages of life. In addition, the central message of the campaign ( recommending five portions a day) was promoted in supermarket stores and other public spaces.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**
The UK Food Standards Agency launched the ‘Eat Well, Be Well’ food campaign which sought to raise awareness of the benefits of eating fresh fruits and vegetables. A key message of the campaign advised that individuals should aim to eat five portions of fruit and vegetables every day. The campaign was directed at consumers rather than business. The primary methods of communication were the use of TV advertisements, leaflets and posters. In addition, the key message (of recommending individuals should eat 5 portions of fresh fruit or vegetable every day) was delivered in a range of public spaces, ranging from, for example, pharmaceutical stores and health care centres to food retailers.

6. **What is the good practice in this example? What makes the good practice unique?**

**What goes beyond usual practices? How do they make transparency work?**

The good practice in this example was the simplicity of the message. This enabled the ‘Eat well, Be Well’, campaign message to be shared and passed on by a range of actors, thus contributing to its effectiveness in attaining a significant amount of awareness among the UK population. Transparency was also enabled by the creation of a website which provides greater detail on the campaign and other health and diet related information.

7. **What is the part that can be recommended in non similar cases?**

The ‘Eat Well, Be Well’ campaign illustrates how cooperation in the dissemination of key messages around food contributes to the effectiveness of transparency linked to health and dietary messages and concerns around.

For more information: [http://www.eatwell.gov.uk/](http://www.eatwell.gov.uk/)

4.3.7. **Domino’s pizza (Attila Berczeli, CCH)**

**General aspects**

1. **What is the transparency problem?**

Many times the consumers have wondered why the products they buy don’t look as good in person as they do in TV ads. That’s because most of the time companies use artificial techniques to make their products look better than they do when served to the consumers in person.

2. **What is the good practice solution?**

Domino's said the real food photos are part of its "transparency" campaign with customers, which kicked off in 2009 with the introduction of an overhauled pizza in response to negative comments from its guests. The company is going to be real and honest about the taste of the product, they want to be as authentic as possible about how it looks. Domino's created a video demonstrating how it had previously prepped food for advertising. From now they do not artificially manipulate the food. No tweezers, no steam guns, no model knives cutting perfect perforations in the cheese.

In conjunction with the new food photography Domino's launched a “Show Us Your Pizza” online contest and invited consumers to submit photos of Domino's food. Customers' pizza pictures are displayed online at a newly created website.

Another transparency step was initiated on the website of the company. All consumers can track what is happening with their pizza after ordering. The staff of the company keeps the consumer up to date on the status of their order.
3. **What are the benefits and weaknesses from the main stakeholder point of view?**
The new campaign ensures that consumers get information about the whole life of the product and trust in the product which is reliable for them.

4. **What is the tangible result?**
It is a really new campaign, with no information, however there were 134 consumer photos send for 2 weeks.

**Specific aspects**

5. **What is the message? What is communicated to the other businesses and to consumers? How is communicated through the chain?**
“All pizza of our company are reliable.” You know what is happening with the ordered product at all time. The products that you buy look as good in person as they do on television or the picture on the packaging material. The company is going to be real and honest about the taste of the product, they want to be as authentic as possible about how it looks.

6. **How do they make transparency work? How do they visualize the message/information?**
The company does not artificially manipulate the food for food photography (advertisement, photos on the website). All consumer can trace their own pizza on the website, they can make sure that the product is real fresh and all steps are in time (or not).

7. **What are the technical devices/means do they use for the visualization?**
All steps were communicated on the company website. The demonstrating video and the consumers’ pizza pictures are displayed online at a newly created website. Also on the company website all consumers after ordering can track what is happening with their pizza.

Reference: Parseghian, Pamela (July 7, 20). Nation’s restaurant News

4.3.8. **Matured beef** (Andras Sebok, CCH)

**General aspects**

1. **What is the transparency problem?**
The transparency problem that was faced in the meat sector in Hungary concerned matured beef. Beef passports provided good identification during lifetime but when the meat was cut, identification became more difficult. Poor practices in maturing beef caused by the lack of experience of the consumers, and mistakes made by the caterers spoiled the quality advantages of hungarian simmental cattle meat. Consequently it was impossible to justify claims like ‘prime quality cattle’ or ‘hungarian simmental cattle’ wherefore premium prices are received. Farmers that invested a lot of money to produce this kind of beef, became very suspicious about cheaters.

2. **What is the good practice solution?**
To solve this problem, the Association of the Breeders of Hungarian Simmental Cattle established complete traceability and an assured quality system was set up till the end product. Standards were formulated, that indicate how to keep the animals. The product is carefully graded by quality and matured accordingly in a specific retail packaging. All cuts are packed in one location. In addition, Collective marketing tools were applied

3. **What are the benefits and weaknesses from the main stakeholder point of view?**
The new solution ensures that consumers get uniform, reliable, prime quality, matured beef products. The system integrates all steps till the final use and prevents mistakes of the end users, which may spoil the premium quality. The centralized retail packaging can be better controlled, which prevents adulteration, and mishandling, improper segregation by inadvertent mistakes, the most critical steps of managing the meat segregation in the value chain. The joint brand makes collective marketing easier.

4. **What is the tangible result?**

Nowadays Hungarian simmental cattle meat, provided with an umbrella brand that belongs to the Association of the Breeders of Hungarian Simmental Cattle, is on the market in Hungary. The product is distributed by one retailer, Cora.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**

The quality advantages are real in Hungarian Simmental cattleʼ products. All consumer can be sure of the origin of the meat. The products are reliable, the premium price is commensurable to the value.

6. **What is the part that can be recommended in non similar cases?**

The solution ensures that consumers get uniform, reliable, prime quality, matured beef products. The system integrates all steps till the final use and prevents mistakes of the end users, which may spoil the premium quality. The centralized retail packaging can be better controlled, which prevents adulteration and mishandling, improper segregation by inadvertent mistakes, the most critical steps of managing the meat segregation in the value chain. The joint brand makes collective marketing easier.

References:  [http://cora.hu/markaink/iz/receptgyujtemeny/5_Iz_es_Hagyomany](http://cora.hu/markaink/iz/receptgyujtemeny/5_Iz_es_Hagyomany)  [http://www.agrarkutatas.net/tudastar/elem/id/318/Magyartarka-=garant%C3%A1lt-min%C5%91s%C3%A9g-‐ıththonr%C3%B3l=‐%C3%89rlelt-marhah%C3%A9s-term%C3%A9kek-a-cora-%C3%A1ruh%C3%A1zakban](http://www.agrarkutatas.net/tudastar/elem/id/318/Magyartarka-=garant%C3%A1lt-min%C5%91s%C3%A9g-‐ıththonr%C3%B3l=‐%C3%89rlelt-marhah%C3%A9s-term%C3%A9kek-a-cora-%C3%A1ruh%C3%A1zakban)

4.3.9. **RFID for monitoring storage conditions** (Henry Jäger, TUB)

**General aspects**

1. **What is the transparency problem?**

During food storage and transportation, the storage temperature plays a major role in order to maintain food quality and safety especially for easily perishable products. The storage temperature can be controlled at certain steps of the transport chain, but the transfer of information in between these steps is missing since documentation is incomplete.

2. **What is the good practice solution?**

Temperature Loggers are a low cost solution consisting of semi-passive UHF tags that allow to monitor temperature sensitive products during transportation and/or storage. These loggers can be used with RFID readers available on the market without requiring any additional equipment. A programmable temperature logger can identify problems incurred with produce during cold chain storage and transit, thus providing an improved quality control system for food manufacturers.
Temperature loggers may have a memory capacity of around 8,000 samples, and can be customized according to a food producer’s particular monitoring requirements.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**

Temperature loggers are recommended for recording temperatures during transportation and/or storage of temperature-sensitive goods such as fresh or frozen food. They allow temperature monitoring along the supply chain by applying a cost effective solution. Then transfer of recorded data is easily possible between different steps of the production/transportation chain. It is therefore possible, to estimate product quality and safety to a certain extent based on the obtained temperature profile. It can therefore contribute to enhance the cold chain quality control.

4. **What is the tangible result?**

The system provides an objective mean for the recording and documentation of temperature which is one of the most important parameter during food storage regarding food safety and quality.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**

Also in this case, no direct communication to the consumer takes place. The retailer has the possibility to judge the product quality not only by evaluating the product itself, but also by evaluation of available temperature monitoring data which give additional information on the product history and possible negative effects on food quality characteristics. On the other hand each supplier can prove the fulfillment of relevant storage and transport conditions. Finally, quality characteristics are the basis for product price and acceptance of a certain raw material. Communication takes place in both directions along the production chain.

6. **What makes the good practice unique? What goes beyond usual practices? How do they make transparency work?**

Temperature monitoring and recording along the production chain offers the possibility to control and maintain product quality. Control actions can be applied immediately and quality losses and remaining shelf life can be predicted even before they are directly visible on the product by interpretation of the temperature history of a product.

7. **What is the part that can be recommended in non similar cases?**

RFID is a valuable tool for monitoring and recording of data along the production chain. It can be attributed to a certain batch of product or even to single units and allows a complete and consistent transfer and availability of data.

4.3.10 . **Plukon Royale Group** (Olga Kehagia RLabs Market Research Ltd.), Katrien Van Lembergen, Adrienn Molnar (UGent))

**General aspects**

1. **What is the transparency problem?**

The transparency problem faced in the fresh and frozen chicken and poultry sector consisted of the lack of a traceability system to provide optimal service to its customers, in both the fresh product and deep-frozen segments.

2. **What is the good practice solution?**
To solve this problem, the group's plants (two separate places) employ the very latest methods to slaughter and process fresh poultry meat in accordance with the demands of the German retail market. The establishment in one of the plants also produces fresh meat products and sausages for the German retail market. Most of the products, which are distinguished for their quality, are sold in Germany under a specific brand name. The company also has a system to monitor the entire process from the breeder to the consumer.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**

Although the main stakeholders are probably consumers, most other stakeholders will also benefit. Benefits to consumers entail lack of attribution of dishonest motives to the supply chain and decreased uncertainty. Complete domestic supply chains or supply chains providing reputable origin food products are also probable to command premium prices.

4. **What is the tangible result?**

With Poultrace the company is able to closely monitor the entire process from the breeder to the consumer. Fraud will be diminished in the whole supply chain and consumers will gain trust on the products by accessing the information they need for assurance of safety for poultry products.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**

Plukon Royale Group products, sold under a specific brand name, can be distinguished for their quality. These fresh and deep-frozen products, mostly delivered to the retail market, are part of the top segment of the processing industry. The group also takes responsibility for sustainability, animal welfare and environmental management.

6. **What is the good practice in this example? What makes the good practice unique? What goes beyond usual practices? How do they make transparency work?**

The company has a system, Poultrace, to monitor the entire process from the breeder to the consumer. De Kuikenaer, an independent division of the Pulkon Royal Group is responsible for the entire chain management.

7. **What is the part that can be recommended in non similar cases?**

The system is based on availability, constant product quality and traceability.

For more information: [http://www.plukonroyalegroep.nl/english](http://www.plukonroyalegroep.nl/english)

4.3.11. **Smart Packaging** (Henry Jäger, TUB)

**General aspects**

1. **What is the transparency problem?**

Packaging is a key factor to maintain and control product safety and quality during food storage. Avoiding recontamination by a mechanical barrier as well as providing a suitable environment for product storage such as modified atmosphere are some important points. However, traditional food packaging does not allow the control of some critical conditions that may occur during food storage such as increasing storage temperature or the occurrence of microbial growth.

2. **What is the good practice solution?**

Smart packaging provides the possibility for the control of some food quality and safety aspects during storage. Freshness systems are the most important application area for smart packaging in the
sector. Several kinds of smart packaging are currently available. These include freshness indicators, which are smart labels that indicate the freshness of food through some kind of color change. Other kinds of smart label serve as time-temperature indicators (TTIs). The technology is finding increasing use in supply chains for foods that are highly temperature sensitive. Current TTIs providers include Bioett, Timestrip, KSW Microtec, Infratab TempTime, Information Mediary, 3M and Vitsab. Several companies are using smart packaging in this way, including Campbell with its self-heating soup and MeaWestvaco's NanoCool packaging system. Another growth area is anti-pathogen packages that detect and warn the user of the presence of serious bio-contamination.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**

Smart packaging attributes the jump in growth to changing consumer patterns - especially greater health consciousness - a demand for easy-to-cook meals, changes in demographics, an increasing use of anti-counterfeit techniques and the need to ensure the freshness and usability of packaged foods.

4. **What is the tangible result?**

Smart packaging contributes to the improved control of storage conditions and related food quality and safety aspects. It may also provide some means to avoid or limit the occurrence of quality deterioration or safety concerns.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**

In this example, the consumer is directly affected since food packaging is one communication platform between food manufacturer and consumer. Smart packaging may include indicators that allow the consumer to identify spoiled products or products that have not been kept in the cold chain consistently. However, the consumer needs to get some instruction on how to interpret these signals and indicators.

6. **What is the good practice in this example? What makes the good practice unique? What goes beyond usual practices? How do they make transparency work?**

These systems provide a tool to the consumer to evaluate product quality of the product within the package since the indicator can be read from outside. It may help to warn the consumer before buying a product, but it will also put pressure on the producer and retailer in order to maintain best quality characteristics and storage conditions.

7. **What is the part that can be recommended in non similar cases?**

This is an example for the transfer of quality related information in an indirect way. Normally, quality characteristics are judged by experts based on analytical data or by the consumer based on sensory evaluation. In this example, complex information (including quality parameters but also storage conditions) are converted into a quality indicator that can be read by the consumer.

4.3.12.1. Quality of AOC wines (Tim Hogg, Safe)

**General aspects**

1. **What is the transparency problem?**

Official labelling descriptions alluding to high quality products in AOC wines (Appellation d’Origine Contrôlée). The European wine sector has a legally binding system of classifying wines according to
“quality” categories. In most countries this is essentially tied in with geographical provenance and the concept of “typicity”. (This is a rich environment for transparency issues – with both very negative and very positive examples).

Many regions allow the use of quality attributions on the label – e.g. Reserve or equivalent. Some of these are just fanciful terms which have no legal basis whilst others (such as Reserve) require the wine to be in some way distinguishable (often through analysis) such as having a level of alcohol a certain value above the minimum for that category. The case of alcohol level is illustrative of the problem, the wines are distinguishable but the Reserve is not necessarily of a superior quality.

2. **What is the good practice solution?**

The private operators in many viticultural regions are taking ever greater control over the management of the collective brand which is the AOC region itself. More sophisticated analytical procedures are available, technical staff are more highly trained, subjective tasting is becoming more standardized and, well, objective and Quality Systems are the norm. This allows for better tools to discipline the users of the collective brand and repress practices which might damage it. Thus internal regulations can be used to make quality benchmarks for the use of certain label terms and these can be applied in a transparent way.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**

From the point of view of the quality conscious producer, the increased objectivity and discipline means that the investment which is being made into developing his own commercial brand will not be compromised by others abusing the concept of the collective brand. The increased technical demands have a higher cost. The consumer will gain more trust in the labelling messages as the quality promises on the labels are more consistently delivered by the wine in the bottle.

4. **What is the tangible result?**

An increased confidence in the quality messages on labels of AOC wines.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers?**

The information communicated is firstly that the product complies with a set of objective demands (provenance, agricultural practices (yields per hectare etc.), grape varieties, basic parameters of composition (alcohol content, pH and acidity, color density etc.) and time and type of ageing before bottling which define the specific product type). The “specific type” meaning here a wine of a certain year of harvest, from a specific appellation, of a certain quality level. Compliance can also entail reaching certain sensory criteria which are largely objective.

6. **How is communicated?**

The attribution of the AOC status and the quality level is stated on the label but this requires some deciphering on the part of many consumers.

7. **What is the good practice in this example? What makes the best practice unique? What goes beyond usual practices?**

The AOC system is well known and can hardly, in itself, be considered an original approach. However, the “ownership” of the “collectively-held brand” (which the Appellation is) has, in many regions,
been transferred from a state-owned and run organization, to an inter-professional organization jointly held by official bodies and by the producers and commercial operators. This gradual migration of the ownership, together with greater technical expertise and, of course, the move to the market economy, has led to a major evolution in the significance of many AOCs.

A wine, now presented as a “reserve” under a specific Appellation, can be expected to be of a generally higher hedonic quality than one of the same Appellation but without the “reserve” label. This is supported by objective and measurable criteria which have been defined by the co-owners of the “brand”.

8. **How do they make transparency work?**
Criteria defined by “brand owners”; professionals available to control the criteria; costs of operation (including legally-binding fiscalization) paid for by specific taxes on each bottle put on the market.

9. **What is the part that can be recommended in non similar cases?**
The fact that modern AOCs are jointly-owned and that those which are committed to the construction and defence of the “brand” all have a say in its management. The fact that the costs are supported by fixed contributions is also an important factor.

For more information: [www.aocwines.com](http://www.aocwines.com)

4.3.13. **Gut so!** (Andras Sebok, CCH)

**General aspects**

1. **What is the transparency problem?**
Provision of evidences on the verity of a quality label for Austrian premium quality regional products based on multiple criteria. These criteria include 5 dimensions: (1) nature-preservation and maintenance of landscapes and natural environment; (2) animal welfare and well-being; (3) responsibility for preserving the life bases for future generations — conscious use of energy, high energy efficiency, using renewable energy, minimizing waste; (4) requirements for the economic and social benefits for producers – promotion of small scale and family farming, fair share of sales price handled down the value chain, stable business relations based on mutually agreed conditions, priority for use of products and suppliers from the scheme, treating of employees on a fair way; (5) requirements for the benefits for consumers – high quality products at fair prices, sensory properties checked by an independent professional panel, hygiene/ food safety and quality management systems (HACCP, GMP, IFS etc. as appropriate), GMO free purchasing policy.

2. **What is the good practice solution?**
There are standards for farmers and manufacturers for milk and dairy products, eggs and grain production, storage and cereal and bakery products, which describe the criteria in details. These standards are available for the public free of charge even for consumers trough the website. Each standard contains specific requirements for transparency. For farmers: “The farm is prepared to disclose production processes and to open up its facilities to the local population and to consumers respectively (e.g. information desks or panels, day of “open farm gate” once a year.” For mills and food processors: (1) Preparedness/ readiness: “The company is prepared to disclose production
processes and to open up its facilities to the local population and to consumers respectively (e.g. information kits for interested visitors, day of “open doors” once a year).” (2) Origin of ingredients: “The processing plant sources essential ingredients for the defined gut so product from the region it is located in.” Records and documentation are complete and accessible. Implementation of an effective traceability system and appropriate segregation. Self- assessment tools are provided. Regular external assessment of compliance to the criteria. Performance of the assessors is monitored also. Performance criteria include. Waste balance and CO₂ balance. The use of the label is granted for 1 year.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**

Benefits are that consumers and buyers can check the criteria or even the physical activities which increase trust in validity of statements. Small scale regional products meeting high quality/sensory standards are properly distinguished which contribute to the nationwide access to regional products.

On the other hand, high costs are the main weakness. It is difficult to avoid disclosing of valuable confidential information. High costs of marketing are present, in particular at the starting period when only the number of participants is limited.

4. **What is the tangible result?**

A complex quality labeling system including ethical and sustainability issues specifically designed for food SMEs with several transparency solutions.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**

Provision of evidences on the verity of a quality label for Austrian premium quality regional products based on multiple criteria.

6. **What is the part that can be recommended in non similar cases?**

A complex quality labeling system including ethical and sustainability issues specifically designed for food SMEs with several transparency solutions.

For more information: [http://www.gut-so.at/index.php?mid=7](http://www.gut-so.at/index.php?mid=7)

4.3.14. **Climate labelling for food** (Karin Östergren, SIK)

**General aspects**

1. **What is the transparency problem?**

In early 2006 consumers started to demand information on the climate impact of foods, as a result of the intense debate on the climate issue. The present labeling systems KRAV (organic label) and Svenskt Sigill (IP: Identity Preserved Label) could not meet this requirement since their criteria did not focus on reduction of greenhouse gas (GHG) emissions. Environmental labeling of foods has previously been focusing on more “traditional” issues as eutrophication and pesticide use. One example was that organic produce could well be air freighted to Sweden, and air freight is a practice that was clearly not “climate smart”.
2. **What is the good practice solution?**
The two certification organizations (KRAV and Svenskt Sigill) jointly initiated a project to develop criteria that focused on GHG’s. The initial suggestion was to have a separate climate label, since too many of the producers presently labeling their products should not be able to meet the new criteria; the ambition was a “best-in-class” label. Together with experts on food and environmental impact state-of-the art reports on different product groups (dairy, vegetables, poultry, pork, beef etc.) where compiled, and the experts suggested criteria for the different product groups. These reports and suggested criteria were made public and meetings with different stakeholders’ groups were performed. Based on this process criteria were decided upon.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**
For the producers the benefits is that they will have the possibility to communicate that they are doing all one can in order to reduce the climate impact from producing their products. It will facilitate market differentiation. Retailers are mainly negative; they do not want to deal with yet another label. Food processors that want to market themselves as environmentally conscious can gain by having the possibility to use the climate label system to simplify sourcing. Consumers is given the opportunity to make informed decisions and support producers working actively with reducing their climate impact.

4. **What is the tangible result?**
The organic labeling system (KRAV) has decided to incorporate the criteria in the organic label, which leads to more focus on GHG emissions, but a delay in implementing. The IP label (Svenskt Sigill) launched the first climate labeled products in May 2010. Perhaps the most tangible result so far is the initiation of discussions throughout the food sector and general increase in knowledge about foods’ climate impact made possible by the work on finding and motivating the criteria. All reports are publicly available on the web and works as a kind of reference documents for many players in the debate.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**
The message to the consumer is that the labeled product has been produced according to a list of criteria. The criteria is available at a website, where all background material used in the development of criteria is found.

6. **What makes the good practice unique? What goes beyond usual practices?**
The good practice consists of a combination of two parts. The first is that the criteria has been developed based on best available scientific knowledge, instead of a lot of prejudices on what is good (e.g. "transports are bad", "organic produce is always better"). The second part of the good practice is the use of production criteria instead of quantifications, which means that implementations can go faster, and that updates are possible when new knowledge is available. The first part, starting what we know from research is not unique, but not very common in development of labelling schemes. The transparency is achieved by completely open criteria, all background reports available at the same website and finally a third party certification

7. **What is the part that can be recommended in non similar cases?**
The process of developing the scheme, i.e. starting with the state-of-the art knowledge, involving researchers from the beginning. This was then followed by a process of stakeholder-meetings and open consultations.

For more information: [http://www.klimatmarkningen.se/in-english](http://www.klimatmarkningen.se/in-english)

4.3.15. **CareTrace** (Donna Simpson, City)

**General aspects**

1. **What is the transparency problem?**
Fairtrade has helped in achieving better outcomes for growers and producers in the global south. Certification of fairtrade products has facilitated the mainstreaming of fairtrade. While fairtrade certification provides assurance for consumers, some consider that there is a lack of transparency regarding the impacts and suggested benefits of fairtrade. Moreover, it has been suggested that producers and growers do not always know who receives their fairtrade goods. Transparency is important in this situation because fairtrade schemes publically promote a commitment to create overall benefits for growers and producers.

2. **What is the good practice solution?**
CareTrace is a web platform that enables consumers to trace the origins of their purchased product. Technology facilitates this form of transparency. Using a dropdown menu, consumers enter the ‘use by date’ and select the product type. The result shows detailed information which seeks to ‘tell the story of the product’. Information is communicated on producer-blogs, maps and photo galleries. The content of the information is detailed and includes information of the organization of fairtrade cooperatives as well as insights on growing and harvest.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**
The main benefit is that the web platform is user friendly and enables consumers to access detailed information on fairtrade communities and sustainable productions aims more generally. Moreover producers and growers can maintain and contribute to blogs, (which consumers can respond to). A main weakness is that there exists a lack of independent verification of the content of the website including how information displayed is edited and selected. Further, the scope of the coverage of the products is limited with the website featuring seven product lines for two retailers in the UK.

4. **What is the tangible result?**
Internet technology is enabling communities and consumers to ‘virtually’ meet. CareTrace represents an innovative approach in which traceability is used to create transparency. The scheme allows for up to date information. For example, most recently the cancellation of flights in and out of Europe due to volcanic ash has led to the temporary closure of the processing factories featured on the website. The site enabled news to be shared of the impact of this event.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**
Caretrace primarily focuses on communicating with consumers rather than with businesses. The information that Caretrace seeks to communicate relates to: origin, production method and issues around sustainability and, social aspects of food production. The method of communication relies on the use of labels and the internet. The Caretrace webpage invites consumers to type in the ‘use by date’ and product type (e.g. watermelon, pineapple). This approach enables consumers to retrieve
more detailed information about their product. Consumers are able to explore maps to reveal the origin and location of production, watch videos, view photo galleries and read blogs to find out more about the producers, workers and the production process. Consumers may also interact with producers by leaving comments on the blogs (authored by producers).

6. **What makes the good practice unique? What goes beyond usual practices? How do they make transparency work?**

Transparency in this context relies on participation (of both consumer and producer) and the internet. The good practice in this example is the utilization of routine and mandatory information (for example, the ‘use by date’ and product type) to provide unique insights into the lives and experiences of producers as well as information concerning sustainability. Transparency goes beyond the usual practices because the use of information not only enables traceability but also provides a platform in which consumers and producers have the potential opportunity of ‘virtually’ meet. Thus, consumers can find out up to date information about where their product came from and, producers can find out more about who is the final purchaser and consumer of their product. It is this two-way transparency that makes this good practice unique.

7. **What is the part that can be recommended in non similar cases?**

As stated previously, the Caretrace is a good example of how the most basic type of information can be used as a gateway to access more in-depth, up to date insights.

For more information: [http://www.caretrace.com/index.aspx](http://www.caretrace.com/index.aspx)

4.3.16. **Marine Stewardship Council** (Ulf Sonesson, SIK)

**General aspects**

1. **What is the transparency problem?**

Fisheries sustainability has previously mainly been addressed by NGO’s by campaigning against consumption of certain fish species where stocks are threatened (e.g. cod in the Baltic) or where endangered species are caught as by-catch (e.g. dolphins killed in Tuna fisheries). Since there is very weak links between producers (both fishermen and processors) and consumers in the fish supply chain it was impossible to transmit differences in fishing practices and also different stock status in different oceans (e.g. cod stocks in the Baltic are under pressure, but cod stocks in the Barents sea is generally well and sustainable managed). So, it was not possible to affect consumer behavior by making the fisheries more sustainable, and consumers didn’t feel they could make a difference.

2. **What is the good practice solution?**

The solution was a joint effort by processors (Unilever), NGO’s (WWF) and fishing communities called Marine Stewardship Council (MSC). They described criteria for sustainable fisheries which were approved upon within the group and a certification scheme and certification body. The criteria are mainly focused on fish stock status, but also social aspects are considered. Fisheries could then apply for MSC certification from a third party certifier and their products could be labeled on consumer packages. Fisheries are certified for a period of 5 years, then they need to be re-certified.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**

The main benefit is that actions to make fisheries more sustainable could be communicated to consumers that then could make informed decisions. This meant than a value was added to products and fish processors could work with avoiding unsustainable fisheries by choosing MSC labeled raw
materials, as many companies do. Also retailers can use the MSC as purchasing criteria so as to avoid NGO campaigns.

The strengths are mainly that the system is credible since business and NGO and the fishing communities support the system. It is also simple, just to look out for the MSC label on the packaging, be it a frozen fillet of cod or a pack of fish fingers.

The weakness is that the criteria must be applicable on all fisheries globally, which means that it is difficult to define detailed criteria. The certification is also costly. Information regarding the criteria that MSC builds on can be found on the MSC webpage, however it requires high level of interest from consumers to purposely look up these information. Further, only fisheries with very high level of interest in sustainability issues would decide to take part of it.

4. **What is the tangible result?**

Many companies, both in retail and processing are using the MSC as their main tool for working and communicating about their sustainability work to consumers.

**Specific aspects**

5. **What is communicated to other businesses and consumers? How is it communicated?**

The message to the consumer and business is that the MSC labelled product comes from fisheries that meet criteria on that fish stocks are managed sustainable, that the fishery does not damage marine ecosystems and the appropriate management systems for fish stocks are in place and followed. The criteria and assessment documents from certified fisheries are available on the MSC web page.

6. **What makes the good practice unique? What goes beyond usual practices? How do they make transparency work?**

The open access to both criteria and assessment is important. The stakeholder involvement in the definition of the criteria is also a strength. Transparency can be said to be passive, i.e. interested parties need to find the information themselves on the web. The third-party certification and strict traceability strengthens the credibility.

7. **What is the part that can be recommended in non similar cases?**

The stakeholder involvement in developing the scheme. The open access to both criteria and, very important, assessment reports for individual fisheries. The fact that MSC is a non-profit, independent organization gives it credibility among consumers.

For more information: [http://www.msc.org](http://www.msc.org)

4.3.17. “Frilandsgris” - **Free range pigs** (Lizzie Melby Jespersen, ICROFS, AU)

Danish Animal Welfare Scheme – Friland (Denmark)

**General aspects**

1. **What is the transparency problem?**
Public concerns regarding animal welfare has stimulated business to guarantee and market animal products from animals that have had better welfare than what is set by the legal systems. One example of this is the labeling of meat from free range pigs and beef cattle from the sales company, Friland A/S under the Danish multinational slaughterhouse company, Danish Crown - that is labeled Recommended by the Animal Welfare Society. The question is how the improved animal welfare is assured, how it is verified and how the consumers have access to information about the animal welfare criteria etc.

2. **What is the good practice solution?**

Friland’s animal welfare scheme is established in cooperation with the Danish NGO, the Animal WelfareSociety (“Dyrenes Beskyttelse”). The scheme covers conventional free range beef cattle and pigs as well as certified organic cattle and pigs, and it includes animal welfare requirements under production, transport and slaughtering. The animal welfare standard is very much in line with the EU-requirements for organic production, but stricter rules are applied in some cases – e.g. higher minimum weaning age for piglets and 8 hours as maximum allowed transport time for live animals. The specific rules of production are changed according to the development in knowledge of welfare improvement options. The inspection of the producers is a combination of third party control and internal verification according to a program set up by Friland. The third party control is carried out either by the governmental control authority, The Plant Directorate (organic meat) or by the independent control body, DB Kontrol (Free range), which was established by the Animal Welfare Society, and which is accredited according to ISO65/EN 45011 by DANAK. Minimum 1 unannounced control per year is carried out. The rules for production of "Free Range" pigs and cattle can be found on the website of [www.friland.dk](http://www.friland.dk), where there is also a link to the production rules for organic meat. The ‘outdoor’ pig and beef cattle schemes not only differ from conventional meat production as regards the animal welfare requirements but also in relation to the quality requirements for the meat - and for the beef cattle meat there is even the possibility for the consumers to trace the meat back to the producer of the meat. Friland has developed a public traceability system based on the identification codes (CKR numbers) of the farms : [www.sporditkod.dk](http://www.sporditkod.dk). By entering the CKR code on the meat package on this webpage the consumer may track the meat back to the farm, where the cattle was reared and also get information on the farmer having produced the animal and how the animals are fed.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**

The main benefit from the producer point of view is the chance to get a premium price for the meat. The benefits for the consumers are 1) they are given confidence that they do not - by their buying behavior - support production of animals that are raised under conditions which they find unacceptable and 2) that they get a higher perceived product quality in its wider sense. A weakness in the system is that the animal welfare is evaluated based on a detailed assessment of resources available for the animal, like space, feed and water. This no doubt support animal welfare but does not assure welfare of the individual animal, which an assessment based on the animal welfare of the individual animal might have done.

Also, for the consumer there is no publicly available information on the actual numbers of inspections (though mandatory once per year), the results of the inspections, the infringements found and the sanctions issued. However, for the slaughterhouse and the connected retailers information on herd size, veterinary treatments, feed etc. should be available on the farm for inspection and for Friland and its customers.
4. **What is the tangible result?**

More than 300 Danish Farmers are certified for production according to the Friland animal welfare schemes, and Friland is the biggest wholesaler of organic meat in Europe.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers?**

“Frilandsgris” (Free range pigs) is an animal welfare scheme which is owned by the Danish sales company, Friland A/S, (which is owned by the multinational (Danish) slaughterhouse company, “Danish Crown). Friland has also other animal welfare schemes for beef cattle and for organic pigs and cattle. All these schemes have been developed in close association with the Danish Animal Welfare Society (Dyrenes Beskyttelse).

“Frilandsgris” is sold through three supermarket chains, Irma (high quality food chain), Super Best and Super Spar plus 9 butcher shops situated all over Denmark. All the “Friland” pork meat that Irma markets is already fine cut by the Danish Crown slaughter house, which carries out all the slaughtering and fine cutting of “Frilandsgris”. The slaughter house has an internal control system supervised by the Danish Veterinary and Food Agency. In the Super Best chain, the butchers make the fine cutting of the carcasses themselves after having been educated by the sales company Friland. The butchers are taught about the rules for production of the pigs and the control of the meat. The butchers of Super Spar super market chain and the butchers of the nine slaughter shops, who also make the fine cutting themselves do not have a similar education, but it is the intention of Friland to offer that in the future.

The control of the farmers producing the pigs is carried out by a DANAC accredited independent control body under the Danish Animal Welfare Society. There is regular contact between the butchers or meat packaging staff responsible for Friland pork products in the super market chains and butcher shops and Friland, which reduces the risk of fraud. With each meat delivery is sent a number of “Frilandsgris” labels corresponding to the approximate number of meat packages sold plus brochures on the requirements and control behind the label to be handed out to the consumers.

An even more interesting Friland example as regards transparency is the “Friland kødkvæg” (beef cattle meat) from 11 different beef cattle breeds. Every packet of meat is marked with the name of the breed and the identification number (CKR) of the farmer. On the Friland web page, “trace your meat” (“spor dit koed” [http://www.sporditkod.dk/]) the consumer can enter the CKR number and look up the name of the farmer and get information on the breed and the farm, where the animal was bred and how the animals are fed. (The meat is controlled and labeled in the same way as the Friland pork meat.)

6. **What is the good practice in this example?**

For the pig meat: the transparency due to close co-operation between Friland and the staff involved in the fine cutting and packaging of the meat products in the three supermarket chains and nine butcher shops.

For the beef cattle meat – the possibility for the consumer to look up where the meat comes from and learn about the farm and how the animal was fed – it is nice for the consumer to know where exactly the meat comes from.
7. **What is the part that can be recommended in non-similar cases?**

Close co-operation between food quality scheme and retailers – education of retailer staff to make them aware of the special qualities, which cannot be seen e.g. feeding requirements, animal welfare aspects etc.

For more information: http://www.friland.dk/page2299.asp

### 4.3.18. European Food Price Monitoring Tool (Katrien Van Lembergen, Adrienn Molnar, UGent)

#### General aspects

1. **What is the transparency problem?**

Due to strong turbulences in price evolution at each step of the food supply chain, the European Commission proposed ways to improve the functioning of the food supply chain in Europe to deliver permanently competitive prices for European households in its December 2008 Communication (Food prices in Europe). In October 2009, the European Commission concluded in another Communication (A better functioning food supply chain in Europe) that there are significant imbalances in contractual relations between actors in the food supply chain. These imbalances are the result of the diversity of active actors in the chain and their differences in bargaining power. Further, this Communication also highlights the lack of transparency of prices along the food supply chain and the increased volatility of agricultural commodity prices. To overcome these challenges and improve the functioning of the food supply chain, the Commission proposes among others to increase transparency in the food supply chain by publishing the European Food Prices Monitoring Tool.

2. **What is the good practice solution?**

The European Food Prices Monitoring Tool was developed in the second half of 2009 and published in October 2009 by Eurostat, in cooperation with DGs AGRI, ECFIN and SANCO. The aim of this tool is to monitor markets by following price transmission for food products along the food supply chain. The tool didn’t try to show detailed national statistics, but rather aimed at EU level comparison. Hereby, a simple representation of the food supply chain is used, showing price developments for agricultural commodities (ACP: agricultural commodity price index), the food industry (PPI: producer price index) and consumer foods (HICP: harmonized index of consumer prices). Data on 17 food supply chains are included in the tool, based on existing Eurostat publications (since 2005) for EU and 27 member states.

3. **What are the benefits and weaknesses from the main stakeholder point of view?**

Different aspects indicate the importance of the European Food Prices Monitoring Tool:

- Transparency may overcome the problem that each player in the food supply chain has his/her own idea on how prices develop, where sellers want to have a fair income and buyers want to have a fair price.
- Food prices are of primary importance for inflation.
- Food is a basic need (purchase decision cannot be postponed)
- Food prices are very volatile. This volatility depends on many factors and in order to be able to understand these factors (and consequently volatility) it is of high importance to understand the functioning of the food supply chain.
Therefore, Eurostat developed this tool. This tool allows the European Commission and other stakeholders to understand the price development at the different stages of the food supply chain and the pass-through of price developments along the food supply chain, which may lead to a better performance.

Further, some weaknesses can be identified:

- Sometimes, it is difficult to show how prices are transmitted and it is not possible to picture all costs and prices. Therefore, Eurostat decided to focus on selected levels of the food supply chains.
- It is difficult to have comparable data at the different levels of the food supply chain because products change during the process (from farm to fork). Also the production process, trade and transport costs differ across products, countries and producers.
- Inputs such as labor cost, energy etc. are also important but not included in the tool. Maybe in the future, it will be possible to include also prices of these inputs. Eurostat has data available on prices for various inputs for example energy prices, but it is very complicated to establish the importance of each input in each supply chain and to include it in the tool.
- Eurostat is trying to update the tool by including international trade data. This data is available, but it is difficult to select the relevant trade flows and calculate price indices for them and then to include these in the tool.
- Part of the price development also takes place outside the food industry such as transport and wholesale.
- Currently, data from some countries is missing in the tool. Eurostat tries to solve this problem, but in some cases there is a good reason why there is no data available (e.g. product is not produced in that country).
- It is difficult to find a good balance between details (complexity) and understandability (transparency).

4. **What is the tangible result?**

The European Commission concluded that price transparency in the food supply chain is not sufficient. Therefore, the European Food Prices Monitoring Tool was developed. This tool has an important value for the European Commission but also for other stakeholders.

Further, the High Level Forum for a Better Functioning Food Supply Chain was established. Several Ministers, CEOs of major companies in the food industry, trade associations and NGOs are member of this forum. Based on their recommendation (that more transparency along the food supply chain is necessary), the tool will be further developed.

Eurostat focuses on European comparison instead of national comparison. They work together with authorities and institutes to receive more detailed information. Detailed analyses at national level are considered national responsibilities.

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**
Price indices for three players (farmer, food processor and retailer) in the selected food supply chains in Europe are communicated via figures on the internet that can be requested by everybody. These price indices make it possible to compare data across European countries (not at national level).

6. **What is the good practice in this example? What makes the good practice unique? What goes beyond usual practices? How do they make transparency work?**

This is one of the first initiatives that tries to provide transparency for price transmission along the food supply chain (including several levels) which makes it possible to compare price development in the different stages of the food supply chain. It is unique that the communication is not going along the food supply chain, but an external (trusted) third party collects data and communicates it. This increases trust, no bias from the food supply chain partners. They include a wide range of national stakeholders in collecting the data that is included in the tool, but still they make it simple, easy to handle and understandable.

7. **What is the part that can be recommended in non similar cases?**

Analysis of the entire food supply chain (including several levels). Involvement of external (trusted) third party. Wide range of national stakeholders are involved, huge data set, but still simple, easy to handle and understandable.

For more information:

http://ec.europa.eu/agriculture/foodprices/index2_en.htm
http://ec.europa.eu/economy_finance/articles/structural_reforms/article16028_en.htm

4.3.19. **Electronic product code** (Daniel Martini, KTBL)

**General aspects**

1. **What is the transparency problem?**

Identification of objects like e.g. traceability reference units is easily done in closed and controlled systems. In most cases serial identifiers, sometimes hierarchically assembled, are generated. However, there may be limits given to the length of identifiers by tag size or hardware constraints. Thus, in practice, the value spaces of different identifiers (e.g. the ones for packaging units and the ones for packing locations) mostly overlap. But on the level of a system implementation for a globally scalable tracing solution, it is necessary to differentiate.

2. **What is the good practice solution?**

The good practice solution involves a regulated hierarchical scheme that allows for enough degrees of freedom for organizations to assign their own identifiers without breaking the whole system by generating identifier clashes. That may be given by mandating the use of fully qualified Uniform Resource Identifiers in all interfaces exposed to the outside world as for example done in the EPCIS (Electronic Product Code Information Services) specifications for EPC tracking and tracing solutions.
3. **What are the benefits and weaknesses from the main stakeholder point of view?**

**Benefits:**
- Extensibility of the system for handling future requirements or for providing further identifiers for special needs.
- Assuming proper use, global uniqueness is guaranteed.
- Simple organization of the assignment process is possible (assignment at different levels can be distributed across several organizations/organizational units, existing infrastructures can be used (e.g. Internet Engineering Task Force facilities)).
- In the future, the addressability given by Uniform Resource Identifiers (i.e. direct web data retrieval on a global scale by just entering the identifier into an IT system) might play a role as well.

**Weaknesses:**
- Long identifiers.
- Implementation might need a little “getting used to” by “old-style” database-savvy programmers (open world vs. closed world).

4. **What is the tangible result?**

Real unique identification, global scalability of systems, easy adaption to future needs

**Specific aspects**

5. **What is communicated to the other businesses and to consumers? How is it communicated?**

The Electronic Product Code is originally a system for tagging and identifying products uniquely. During the last few years, the principles behind it have been applied to other identifiers as well, e.g. global location numbers (GLNs) and there have been extensions allowing for higher amounts of data to be captured by encoding, thus enabling more complex identification and tagging tasks. Communicated to other businesses and to the consumer is only the tag with the code, usually printed and encoded as a bar code.

6. **What is the good practice in these example?**

The good practice lies not in the code as such but rather in the infrastructure behind it and the methods applied in assigning codes and handling them. The EPC Information Services e.g. allow for retrieving information on relevant events in a supply chain like shipping and receiving of goods and the accompanying data like a timestamp, shipping company etc. Further information could be easily provided by similar services. Crucial for this to work is an identification system that functions across stakeholders internal databases. EPC Identifiers are globally unique. Control of number spaces is distributed in a hierarchical manner, i.e. a stakeholder has an assigned range of numbers, from which he can choose. When querying information on a certain product using an EPC and the EPC Information Services, a Uniform Resource Identifier (URI) is built from the code. This mechanism allows for future extensibility and new coding systems (e.g. for lots or single product items) to be added later on. An additional benefit comes from the fact, that for a URI a so-called dereferencing
mechanism can be defined. That way, the identifier can serve as an address to a location, where further information upon a certain item can be found. Syntax and semantics of a URI are standardized with necessary specifications publicly available for free, so that they can easily be applied without preliminary investments.

7. **What makes the good practice unique? What goes beyond usual practices?**

The good practice is currently unique in its application of robust mechanisms for distributed identifier management. A lot of tracking, tracing and quality assurance systems still use internal numbering of items only. While this can serve very well to manage a single information system to store and handle data on items in a single company or a short supply chain, it does not work at all for sector-wide transparency, as there will be identifier clashes as soon as further systems are networked.

8. **How do they make transparency work?**

Codes like the EPC are not directly enhancing transparency by communicating information. But they are enablers to transparency by allowing retrieval of further information depending upon demands and interests within a distributed network like the one of food chain participants. Systems providing information on items like food products can relatively easily be built once a robust and global identification and coding mechanism for objects is in place. Future potential lies especially in codes readable by mobile phones (with camera). Additional information on a tagged item can thus directly and in a timely manner be queried by stakeholders.

9. **What is the part that can be recommended in non similar cases?**

Recommendations mostly apply to producers of software systems delivering information on food products to enhance transparency:

- Think about networking with other systems: design identifiers in a way that they can easily be made globally unique.
- Design an identification system in an extensible manner. There may be new levels of identification that have to be communicated. E. g. future demands may call for unique identification of places, machinery used or processes instead of only products.
- Use common, generic, openly available and standardized mechanisms like Uniform Resource Identifiers (URIs) for building tagging, coding and identification systems.

4.5. **Recommended sub-domain specific transparency practices**

Based on the analysis of the transparency challenges and successful transparency practices in different domains and sub-domains the following sub-domain practices can be recommended:

4.5.1. **Transparency instruments for Food Safety and Quality concerns**

**Scope**

- In the food safety and quality domain end users are more interested in the actual characteristics of properties of the food (lot, batch), what is on their plate, while in the area of food sustainability and integrity end users are more interested in the long term impacts, than in the use of an actual batch.
Successful transparency practices

- In the food safety area information usually has a proactive nature on measures applied to prevent the negative effect on human health, including compliance to legal requirements on the level of hazards, and on provision of information on content of substances, which may cause negative consequences for sensitive groups (allergens), or rejection based on ethical concerns (meat in vegetarian food). Information of negative nature is also typical in the case of a food safety crisis, product recall and withdrawal. In other cases, such as at health and nutritional claims the application of the information of positive enhancement nature is regulated by the legislation to avoid such marketing messages, which may mislead the consumers.
- The transparency information related to food safety should provide a fair evaluation of the risks in addition to the benefits.
- Mandatory food safety management principles (like the application of the HACCP system) and the voluntary food safety and quality management certification schemes are producing mostly information of proactive nature, except the information on procedures controlling the positive claims.
- In the quality domain both mandatory information and voluntary information of positive enhancement nature is provided on key characteristics of food, on which buying decisions can be based. This information is provided through labelling and non label based methods, and compliance to specific requirements on composition, protected geographical origin. Voluntary information of positive, enhancement nature and proactive nature, including information on food safety verification activities, monitoring of time-temperature in the cold chain, etc. Negative information is also provided at major quality failures leading to product withdrawal and recall.
- The food safety and quality domains can be divided into several sub-domains such as compositional information on the nature of the food and feed as being free from chemical, biological/microbiological and physical hazards or complaint with the relevant legislation or specifications, reliability of the testing methods used for verification of statements and claims; technological information covering all steps of the food supply chain; abuse; information on organisational and discipline issues; food quality information including composition health and nutrition claims; sensory properties and hazards, steps of the food chain and authenticity.

Rapid Alert System for Food and Feed

- Rapid Alert System for Food and Feed (RASFF) is an effective tool for food and feed control authorities to exchange information about the food safety risks detected in food and feed in the Member States and on the measures taken for the elimination or reduction of these risks to an acceptable level. According to the Regulation EC/178/2002 when a RASFF member gets any information about a serious health risk deriving from food or feed, it must notify the European Commission and the other Member States using RASFF.
- The information can come from border control, results of inspections and testing of the samples taken by the food control and feed control authorities, from the national markets, food sector companies, health centres or individual citizens.
The typical cases include withdrawal or recall of food and feed from the market because of food safety risks, banning the placement of a food or feed on the market, and placing the food or feed on the market under specific conditions.

The rapid alerting enables the food control authorities to take timely actions. The statistics of the past alerts provide information for the evaluation of risks associated with specific raw materials, products and ingredients and the risks associated with the origin of raw materials, ingredients and products. This general information is publicly available, however at least basic technical expertise is necessary for their interpretation. Therefore is it an appropriate source for transparency information for businesses and policy makers, but less relevant for consumers.

That part of the information, which by its nature needs to be kept confidential is kept confidential within the RASFF network.


**Food labelling**

- Transparency of characteristics of foodstuffs is ensured by the labelling legislation described in the EU (Directive 2000/13/EC) labelling, presentation and advertising of foodstuffs and 90/496 EC nutrition labelling for foodstuffs. (From 13 December 2014 new rules will be applied according to the Regulation (EU) 1169/2011 on the provision of information to consumers, which combines the two directives into one legislation. The principles applied ensure that food labelling must provide appropriate, fair and reliable information to the consumer to allow informed decisions. “The labelling and methods used must not mislead the purchaser …, particularly as the characteristics of the foodstuffs and in particular, as to its nature, identity, properties, composition, quality, credibility, origin or provenance, method of manufacture or production; by attributing to the foodstuffs effects or priorities, which it does not posses; by suggesting that the foodstuff possesses special characteristics, when in fact all similar foodstuffs possess such characteristics.”
- These have to be applied to labelling, to presentation of the foodstuffs, particular their shape, appearance on packaging, packaging materials used and the way how they are arranged or presented and to advertising.
- Specific labelling rules are applied for allergens, GMOs, on caffeine and chinine, which indicate the presence as warning information (e.g. this information has a negative effect for the sensitive or ethical concerned consumer groups), and for nutrition and health claims, which have a positive enhancement nature and for beef, which may have a proactive nature.

**Health and Nutrition Claims**

- Legislation on Nutritional and Health Claims in the EU represent a controversial issue from the aspect of transparency. While significant efforts have been made to ensure the best available transparency for consumers, as a consequence of the complexity of appropriate scientific substantiation the applicable methods are not clear and transparent neither for the industry not for the majority of the scientists. As a consequence of that the approval of new claims or
application of existing claims on new food matrices is very slow and expensive, which represents a barrier for the development new functional foods, particularly for SMEs.

- Within the EU the labelling regulations are based on the principle that any claims made on foods’ labelling, presentation or marketing should be clear and accurate and should not mislead the consumer. In the case of health and nutritional claims because of their complexity these should be based on demonstrated scientific evidences. Only those foods are allowed to bear claims, which has appropriate nutrient profiles, e.g. they do not contain such levels of nutrients in their composition, for which excessive intakes in the overall diet is not recommended.

- Nutrition and health claims made on foods are authorised by the European Food Safety Authority (EFSA) by assessing the scientific evidences supporting the claim. A publicly available list is maintained about authorised and rejected health claims and about permitted nutritional claims and their conditions of application.

- Nutrient profiles were developed based on scientific opinion of the EFSA, consultation with the experts of the Member States and through a public consultation with the scientific community, food business operators and their interest organisations, consumers, NGOs and public health groups to ensure the consideration of both the dietary recommendations and public health aspects and industrial and commercial, cultural and culinary aspects.

**Transparency challenges related to emerging technologies**

- In the majority of the cases there are not generally applicable methods available for assessment of the safety of emerging technologies. There is a lack of generally agreed process performance criteria and indicators. Emerging technologies should be evaluated from the aspects of the effects on digestibility, allergens, bioactive materials and decomposition products, etc. It is not enough to highlight the benefits of a new technology only, but there is a need to inform consumers paralely about the risks associated with these products. In some cases this is particularly difficult since the European consumers in the last 30-40 years have not been used to accept risks associated with their foods. Consumer education and interpretation of the concept of risks and considerations of risks and benefits can help to reduce the negative perception of new technologies by consumers.

**Successful practices for transparency communication in the food safety as quality domain**

- Transparency information for increasing trust in food safety may cover features related to the business environment of the country, where the raw material, the ingredient of the food was produced, such as the legislation and the food control institutions of the country and their operation, statistics on results of testing of samples taken by the food control authorities, records of major food safety incidents. This is used in B2B communication. Consumers can’t interpret this type of information. Seller related features include description of the practices applied by the food businesses, or reference to the certification schemes implemented, together with the indication of the certificates received, and the scope of the certification (B2B communication), and access to the audit reports (B2B communication). Information on product related features include specifications agreed and signed by customer and supplier (B2B), access to the results of the verification of the operation of the food safety management system.
• In addition to the labelling information on the packed food successful examples of communication of information to consumers include:

  • Indicating on the printed menu, on additional leaflets or in booklets and/or on the website of restaurants and restaurant chains the presence of allergens and/or other ingredients, which may cause religious or ethical concerns. The information can also point out items at risk for cross-contamination through frying or grilling. (Examples are presented by “Red Lobster” and “Annotated menu”).

  • Sharing information with consumers on specific lots, they purchased through web-based systems via lot codes/shelf-life dates on retail packaging. This may include the traceability information on the origin, movement of the raw materials, ingredients, products, packaging materials along the supply chain, information on chain members involved in the supply, their practices, virtual tours in their sites, presenting the natural environment around their sites. (Examples are presented in “Gut so”, “Plukon Royale Group”, “Transparency along the entire chicken-chain – Red Master”, “Edeka Guttfleisch”, “Find the Farmer/America”).

  • Launching also iPhone application with the same functions (Example is presented by “Skane majestic: A web-based tool for displaying the origin of the milk, Sweden”).

  • In some cases the results of the laboratory testing and organoleptic evaluation can also be seen (Example is presented by “Terra Creta”).

  • Organising open gates, real factory visits, on site presentations and demonstrations. Provision of detailed explanation of the nature and origin of ingredients through the website to support clean – additive and taste enhancer free labelling. (Example is presented by “Frosta”).

  • Showing the preparation of the ordered product (pizza) through a web-camera. Thus consumers can track, what is happening with their product after ordering. Consumers are invited to participate in an on-line contest, to submit photos of the products they received. These photographs are shown in the web-site of the company. (Example is presented by “Domino’s pizza”).

  • Setting up an assured quality system based on full traceability and centralised packaging at one place, which ensures proper segregation of the product at the critical steps of the food chain. Such specific packaging (retail, vacuum packaging with coloured labels) is applied, which reduces the risk of adulteration. (Example is presented by “Matured beef”).

  • Setting specific standards for distinguishable drink quality, in which collective branding is based. This is supported by sophisticated analytical techniques and stringent internal control. Messages as “reserve” are indicated on the label. (Example is presented by “Quality of AOC (Application d’Origine Conrôleé) wines”).

  • Replacing the names of the suppliers by codes which ensures the protection of confidential information, while still providing information to consumers.

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35 More information can be found on the references in bracket in the Deliverable ”D6.2: Analysis of selected experiences of best practice transparency solutions on enterprises ad food chains” of the Transparent_Food project.
• Maintaining an educational web-site for the consumers, which presents information, videos, quiz’s, activities to promote healthy eating and meal planning, processing and home preparation of a type of product (grains). The information is organised into different age groups of children and for teachers. The solution offers children an easy way to learn. (Example is provided by “Grain Chain Program”).
• Promoting nutritional benefits of a national product group (bread) through a web-site, which promote good food processing practices for nutritional benefits, support local food systems, provide information to support independent SMEs and inform consumers, where the can buy such products. (Example is presented by Real Bread campaign, UK).
• Providing short, clear descriptions of the criteria of the certification schemes and standards in a layman’s style.
• Developing easily understandable visual indicators for the consumers, which can be put on the label and helps them in quick decision making. (Example is presented by “Guideline Daily Amount”).
• Providing a specific label on the products indicating the compliance to specific quality standards like assured production chain. (Examples are provided by “Red Tractor”, “Certus Label”, and “Flandria – EurepGap”).
• Smart packaging indicates the result of food safety history (freshness, time-temperature parameters) to consumers in a direct way. (Example is presented by “Smart packaging”).

• Successful practices for B2B communication of transparency information include:

  • Sharing information with customers on specific lots (via lot codes) based on traceability systems through
    • detailed documentation showing evidences, which support the claim on the specific properties. (Example is presented by “Identity preserved Soy”).
    • on-line database with authorised access. (Example is presented by “Überbetriebliches Tiersgesundheits management”).
    • on-line decision support tools to reduce food safety risks. This can cover formation of chemical contaminants, migration of contaminants from packaging materials, predictive microbiological models to assess risk associated with the growth and survival of pathogens. (Example is presented by “Reduction of acrylamide formation in food”).
    • on-line diagnostic tool for food businesses to evaluate and benchmark their practices to increase the resistance and recovery from deliberate (terrorist) contamination of food products. Four company operation areas are evaluated with this tool: practices, people, supply chain partners, food product. Results are compared to other companies. Also food safety and quality controls are reinforced as participants think about food defence practices. (Example is presented by “Diagnostic tools to Benchmark Practices for Food Defence”).

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36 More onformation can be found on the references in bracket in the Deliverable ”D6.2: Analysis of selected experiences of best practice transparency solutions on enterprises ad food chains” of the Transparent_Food project.
• Operating fully automated track and trace solutions covering the whole process from raw material intake till delivery. Registrations on the shop floor are done using touch screens and mobile bar code readers. The relation between batches is automatically assured in both directions. A subset of data is exported and sent automatically to the main business partners informing them in real time with accurate, relevant data (to customers and suppliers). The data are made available to the food control authorities as well. (Example is provided by “Nollens Poultry”).

• On-line information system on the health situation on farm through authorised access for veterinarians, farmers. The information is updated several times a week. (Example is presented by “Sanibase”).

• On-line education and advisory information for SMEs (Examples is presented by “Real Bread Campaign”).

• Provision of access to the criteria and audit reports in certification schemes. Confidentiality of the audit reports can be ensured by access code or targeted release to designated customers, using logos to signal compliance. (Examples include IFS and BRC Standards.“Certus Label”, “Red tractor”, etc.).

• Using rapid instrumental techniques for monitoring compliance to set food safety and quality criteria at intake of goods. (Example is presented by “Fluorescence spectroscopy for quality determination of fresh pork meat”).

• Accreditation of official national bodies which accredit food safety and quality control testing laboratories. This increases the reliability of test results.

• Using data loggers, RFID techniques for monitoring time-temperature parameters, which can be read at the intake at the customer?

• Provision of a detailed training course (including the number of hours, target and evaluation) in the Good Manufacturing Practice Guide for the restaurant sector. The Guide is validated and approved by the competent authority. Documented evidence can be shown to the inspectors (Example is shown by “Training course on GMP guide for restaurant sector”).

4.5.2. Transparency instruments for environmental concerns

Schemes

• Environmental impact history cannot be measured in a product. Thus the traceability of environmental data must be secured all along the process to obtain transparency. Transparency for environmental impact relies on a proper and transparent communication along the food chain, business to business as well as business to consumers (Östergen et al. 2010a). In business to consumer communication labelling is the most frequently applied method, such as carbon footprint label, Bio Swisse BUD label or Marine Stewardship council.
In business to business communication, provision of information on compliance to relevant environmental standards such as GLOBAL-GAP is more typical.

- For analysing environmental impact of food production a system approach has to be applied. Several different environmental impacts have to be covered simultaneously. The most frequently used method is Life Cycle Assessment (LCA), but there are other methods like ecological footprinting as well.
- Environmental schemes can be grouped into three major categories:
  - good agricultural practice types of schemes – compliance to criteria;
  - organic production – compliance to criteria;
  - climate labelling and carbon foot-printing - quantification and communication of the actual green house gas emission caused by the production.

- Typical elements of the environmental standards, which support transparency:
  - Requirements;
  - Guidelines;
  - Labelling rules;
  - Life cycle analysis;
  - Communication;
  - Auditing.

- Good agricultural practice schemes certify that in the production practice the legal rules and regulations and other criteria were followed. The compliance to these requirements is regularly assessed and certified by third parties. The requirements of the standards are regularly revised and improved. The majority of the systems are based on the GLOBAL-GAP standards.
- Organic agriculture standards include criteria on the use of approved substances, following specific practices described in EU regulations EC 834/2007 and EC 889/2008. Systems and practices are regularly audited to assess whether compliance to criteria is achieved.
- Carbon footprint schemes are mostly aimed to quantify and communicate the actual greenhouse gas emissions caused by the production of the individual businesses.
- Environmental information from many systems is not openly accessible, but kept by either the purchasing companies or by the certification organisation. Criteria are openly accessible in many cases, but the findings of an audit or certification process are seldom open. Application of different levels of compliance criteria in the standard makes transparency more difficult to interpret. Making the criteria openly accessible increases the transparency. When the findings of the audits are also available it contributes to a greater transparency, but a sound balance must be found with the confidentiality needs of the audited business. (Östergren et al. 2010b).
- Results of the inspection are kept confidential and they are available only to business partners of the auditee. In B2B communication access to the results of the assessment of compliance increases trust and credibility.
- There is a large number of certification schemes for food products, which are produced to meet environmental expectations of the society. These cover a wide range of transparency

240
information and solutions, which represent good practices. However the large number of certification schemes in the area conveys the message to the consumers, that the requirements are not fully harmonised, e.g. there is not a general agreement on the criteria. Therefore it results in some uncertainties in consumer acceptance.

Data collection

- For achieving credibility transparency schemes should ensure that the relevant data are collected for verifying the compliance to the environmental criteria.
- When merged data are used the background data and the method of their aggregation should be available by request.

Processing of information

- Environmental impact data, when quantified, are generally based on a large number of data that are classified and weighted to describe the potential impact for a given environmental category, according to the specified rules. Background data are provided in some cases, but only to a certain level of detail (Östergren et al. 2010). More efforts should be made to define the traceability reference unit (TRU) for which a specific claim, statement on environmental issue is related (Hermansen et al. 2010).
- System boundaries have a great impact on the outcomes of the data. Thus a reported value, e.g. the amount of greenhouse gazes (GHG) associated with a product needs to be supported by a large number of data and meta-data to make the calculations fully transparent (Östergren et al. 2010).
- Therefore for increasing the transparency the method applied for the calculation of indicators and data should also be made accessible.
- Environmental data, which are used to characterise different production methods and steps are often calculated as an average, from a number of farms, a country or a region and sometimes for an average of several years. Hence the information as used in product oriented approaches is generally aggregated and can rarely be used to distinguish between similar products (Östergren et al. 2010). However they can be used for indicating the difference between different production methods and different supply chain approaches.
- Main aspects of consumer expectations for information on impact of environmental and ecosystems of food products are: effects on biodiversity, use of energy, emission of green-house gases, effect of the use of pesticides, land use (including deforestations) utilisation of nutrients; water use and depletion of phosphorus.
- Information should be provided on the impact of the compliance to the criteria of the environmental standards of certification schemes.
- Since the range of environmental impacts needs to be covered altogether the transparency information should also cover these complex aspects.
- Development of common and harmonised calculation rules for GHG is necessary to ensure transparency.
- There is an increasing trend in the environmental area that requirements are developed to control the way how environmental statements on environmental impact and performance should be formulated. An example is shown by EMAS.
Communication of information

- Claims and labels are usually used in business to consumer communication, while certificates are used in business to business and business to authorities communication. The details behind the certificates are usually provided separately as printed standards, audit reports or through web-sites accessible publicly or via access codes.
- For achieving transparency there is a need for a consensus on how to communicate environmental information. Based on this standardised indicators should be defined and a standardised way of collecting information should be set up. Good examples for creating consensus are the European Food Sustainable Consumption and Production Round Table initiative and the development of open access databases (such as International Life Cycle Database (ILCD) (Östergren et al. 2011).
- Several labels are applied to communicate that the product was produced according to a set of environmental criteria37:
  - A good practice is to develop the criteria based on best available scientific knowledge and use production criteria instead of quantifications. This enables implementation within a relatively short time and regular updating with the development of the knowledge. The criteria, the background expert reports on which the selection of the criteria was based can be made publicly available in the web-site (http://www.klimatmarkningen.se/in-english/). A third party certification of the compliance is applied. (Example is presented by Svenkst Sigill climate certifications) (Östergren 2011 b)
    - The logo of the product is supported by information on standards, forms, checklists, which is accessible on the web-site (http://www.bio-suisse.ch) Compliance to the criteria is verified by a third party inspection body and by approved accreditation inspection bodies. The standard owner carries out regular retroactive inspections. (An example is presented by Bio-Suisse. BUD label).
    - Provision of a carbon footprint indicator on the label, which is supported by a calculator.
    - A third party verification applied by the Coop Ånglamark private label brand is used for organic food and environmentally labelled products, which are certified by acknowledged existing schemes.
    - For companies, who want to use carbon footprint labelling 3 alternatives are available. All 3 alternatives require independent verification.

Examples for Carbon Labels (Reference: www.climatechangecorp.com):

- **UK: Carbon Reduction Label**
  To get the UK Carbon Trust’s Carbon Reduction Label, companies must register with the Carbon Trust, a UK government-backed consultancy, who can

37 More information can be found on the references in bracket in the Deliverable ”D6.2: Analysis of selected experiences of best practice transparency solutions on enterprises ad food chains” of the Transparent_Food project.
recommend a consultant or directly assist companies to carry out in-house product LCAs. Once carried out, the product LCA is independently verified to ensure that it meets the PAS 2050 standard, which is based on the ISO LCA and greenhouse gas accounting standards and is consistent with GHG Protocol. The company then purchases a licence to use the Carbon Reduction Label.

- **USA: CarbonFund.org**

Interested parties are referred to the CarbonFund.org’s list of preferred life cycle assessment (LCA) providers, who calculate a per product carbon footprint. Any recognised processed-based standards can be used for the LCA, including the GHG Protocol, PAS2050 or ISO 14001. Upon completion, the product LCA is then reviewed by CarbonFund.org, to ensure that it meets the recommended protocols.

- **Canada: CarbonConnect**

A Canadian non-profit organisation, CarbonCounted, provides an open web-based tool, called ‘CarbonConnect’, designed for use by businesses and consultants to track, quantify and manage carbon content throughout the supply chain. The model is designed to engage all suppliers, rather than engaging a singular point of the supply chain. Lifecycle analysis is not a prerequisite and most companies have opted to follow the GHG Protocol method to measure emissions, which uses national level economic and environmental impact data to estimate the amount of carbon embedded in a given product. This method relies on national averages and does not draw on company specific processes or practices. (Example is provided by “Communication of carbon footprint”).

- **Marine Stewardship Council (MSC) environmental standard is targeted to use an ecolabel and fishery certification programme to ensure that the MSC labelled product comes from fisheries that meet the criteria that fish stocks are managed sustainable, that the fishery does not damage marine ecosystems and appropriate management systems for fish stock are in place and followed. Both the criteria and the assessment documents are available on the MSC web page. A third party certification and a traceability system is applied, which increases the credibility. The fact that MSC is a non-profit independent organisation contributes also to the credibility. (More information is available at “Marine Stewardship Council”).

- **Several retail and fast food organisations started to provide climate declarations related to the products, what they are selling. The level of greenhouse gas emission is communicated as a number (E. Leclerc, Max) and on a sliding scale (Casino). The figures in E. Leclerc products indicated on the label are based on full life cycle analyses, using general data for each product group. The Swedish fast food chain Max hamburgerrestauranger uses the assistance of an environmental NGO to analyse the data. The Casino carbon index is a carbon footprint expressed in grams of CO₂ equivalents per 100 gram of end products and on relative scale (from low to higher climate impact). For the calculation a methodology developed by an other organisation and data validated by a public agency are used. Casino provides suppliers with a free**
software for calculations. None of these organisations provide information on sourcing of the data and certification of the calculations. In these cases even if a significant step was made to create environmental awareness and to provide relevant information to consumers the level of transparency is still not advanced (Östergren et al. 2010).

In addition to the labelling information on the packed food successful communication methods, communication of information on environmental issues to consumers include:\(^{38}\):

- operating a common web-site for a sub-sector, where several producers, manufacturers provide information on their farms, companies, products. In the organic food area by entering a code on the product to the web-site (www.bio-mit-gesicht.de) consumers can take a virtual tour of the production sites, get information on location and certification of the companies participating in the production. Additional information is provided on the products and on the organic and biological production practices as well. Consumers can see where the product comes from. (Examples is presented by “BIO mit Geschicht”).
- provision of a carbon footprint indicator on the packaging materials: supported by calculator tools, which generates Cradle to Gate CO₂ profiles for different types of packaging material. Customers can add further parameters (type and size of packaging material, transport distances, etc.) and evaluate a carbon footprint value, which can be indicated on the label. (Example is presented by “Tetra Pak: CO₂ Footprint”).
- Indicators on specific aspects of the environmental impact, such as the distance, what a food product needs to travel from the place of the production to the consumer – represented by the calculation of the “food miles“ - can contribute to the understanding of the food chain. The strength of these types of indicators is that it can provide a simple, easily understandable message on some of the less obvious ecological, social and economic consequences of the global food production. However since other factors are also influencing the CO₂ emissions, such as the means of the transport, the method of the food production etc., care must be taken how to interpret such indicators that they shouldn’t result in misleading information.

Successful practices to B2B communication of transparency information on environmental issues include:\(^{39}\):

- LCA reports on declared products are available on a web-site (www.climatedec.com) , showing selected background data.
- EMAS is an extension of ISO 14001:2004 standard with an additional requirement on external communication. As a part of the EMAS registration an organisation is required to provide an environmental statement on the environmental impact and performance. This statement is available for the public. Registered organisations can use a label during the validity of their registration. the EMAS logo must not be used on products or on their packaging, nor in conjunction with comparative claims (Östergren, K. et al. 2010/a).

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\(^{38}\) More information can be found on the references in bracket in the Deliverable ”D6.2: Analysis of selected experiences of best practice transparency solutions on enterprises ad food chains” of the Transparent_Food project.

\(^{39}\) More information can be found on the references in bracket in the Deliverable ”D6.2: Analysis of selected experiences of best practice transparency solutions on enterprises ad food chains” of the Transparent_Food project.
• WBCSD/WRI Greenhouse Gas Protocol Product Standards adopted by the Sustainability consortium include detailed requirements on public reporting of GHG emissions. The protocol provides a set of standardised tools for businesses and governments to calculate the emissions associated with individual products across their full life cycles and of corporate value chains.

• GLOBAL-GAP is a standard on Good Agricultural Practice, which is acknowledged worldwide. It covers the key aspects of food production on the farm by minimising the negative environmental impacts, reducing the use of chemical inputs, ensuring food safety and a responsible approach to worker health and safety and animal welfare. On its web-site information is available about standards (including control points, compliance criteria, and necessary level of compliance for certification), the list of the certified companies, certifiers, rules for certification bodies and benchmarking information. There is an integrated farm audit standard, which is supplemented with detailed control points for currently 16 sub-groups of plant based, livestock and fish products. The certification is carried out by independent and accredited certification bodies. The standards are revised in every 3 years. to ensure continuous improvements

4.5.3. Transparency practices for ethical and social concerns

• Ethical and social impacts can not be measured on the food product. The information how these aspects were addressed by the product, during its production process and at its production environment can be communicated through transparency processes. In B2C communication labelling can be applied such a fair trade. In B2B communication information can be provided on compliance to relevant standards.

• In transparency of meeting expectations of the society for social and ethical values the level of details of information made accessible for the consumers varies significantly depending on the extent of the actual concerns about the subject.

• Key areas of social and ethical concerns include:
  • **Terms of trade** (fair price for producers and suppliers; fair trade; fair contract terms etc.),
    • main indicator: minimum price paid to the producers. This information may or may not be accessible for the public.
  • **Working conditions** (e.g. labour standards; worker safety and working conditions; hours of work and wage levels etc).
    • main indicators: workers right to be member of unions, the minimum wage paid. This information is typically available, but it is difficult to interpret without knowing the local costs of lives.
  • **Animal welfare** (welfare of livestock and wild animal catch from rearing/capture up to and including slaughter) – mainly ethical but as such raises societal concerns
    • main indicator: housing conditions. Very detailed indicators are developed and accessible for the public, whereas animal based indicators are rarely used.
• **Social capital and community cohesion** (Rural communities’ well being and economic vitality; utilisation and building of social capital of farmers and growers and of communities). The benefits and impacts are rarely available fully to the consumers.

• **Methods of production and processing and religious views** (e.g. organic, IPM/IFM Halal, GM, Kosher, free range or cage reared – animal welfare etc).
  (adapted from Coff, Korthals & Barling 2008)

• Further subjects having social and ethical aspects are related to health and food security, quality and place of origin, and environmental impacts.

More efforts should be made to define the traceability reference units (TRU) for which specific claims, statements on social and environmental issues is related (Hermansen at al. 2011).

**Certification schemes**

• In the sub-domain of social and ethical standards the International Social and Environmental Accreditation and Labelling Alliance (ISEAL) provides accreditation. ISEAL develops codes of good practice for its member organisations. A Code of Good Practice for Assessing the Impacts of Systems is in progress of development and the development of Certification Code of Good practice is planned (Barling et al. 2010).

• Global Reporting Initiative developed a framework for the principles ad indicators that organisations can use to measure and report their economic, environmental and social performance. GRI reporting requirements cover management aspects related to the approach applied by an organisation to achieve its aims and the provision of performance indicators, which ensure comparable information on the economic, environmental and social performance of the information (Barling et al. 2010).

• The objectives and the general description of the criteria of the certification schemes for meeting ethical and social value standards are mostly publicly available through web-sites, whereas the exact compliance criteria meet in auditing, are available only in some of the cases. In other cases these are available only for those who purchase these standards results. As a consequence usually professionals have a full access to the standards, for consumers the price of standards makes the purchase not feasible.

• Results of the inspection of compliance to the standards are usually kept confidential and they are available only to business partners of the auditee. In B2B communication access to the results of the assessment of compliance increase trust and credibility.

• Information should be provided on the impact of compliance to the criteria of the social and ethical standards of certification schemes.

There is a large number of certification schemes for food products, which are produced to meet social and ethical expectations of the society. These cover a wide range of transparency information and solutions, which represent good practices. However the large number of certification schemes in the area conveys the message to the consumers, that the requirements are not fully harmonised, e.g. there is not a general agreement on the criteria, therefore it results in some uncertainties in consumer acceptance.


Communication

- Successful practices for communication with consumers include:
  - Provision of labels based on certification schemes
  - Provision of access to information on the geographical area, on the likelihood and community experiences of the producers through an internet based product tracking systems (CARETRACE). In some applications, where different breeds of beef cattle are used the name of the breeds and the CKR number of the farmers is indicated on each packs of meat. Using this number the consumer can get information on the name of the farmer, on the breed, on the farm, where the animal was breed and how the animals are fed. In the same system for pork a code of practice on animal welfare was developed by the Danish Animal Welfare society (DB), which is used as a basis of specifications for contracted farmers by a slaughterhouse. The DB inspects each farm yearly and grants approval for compliance. The inspection body is supervised by a committee made of all main stakeholders – the members of the DB, farmers, the slaughterhouse, a retailer, and the consumer council. A combined logo of the slaughterhouse and recommended DB is used. The butchers working at the retailers and meeting the consumers are trained on the special benefits of the breeding system, which are not visible, but representing quality features – like feeding requirements, animal welfare aspects, etc. – so that they can explain this information to the consumers.
  - Maintaining an internet based platform where businesses and suppliers can share social and ethical data.
  - The credibility of the animal welfare third party certification can be increased if all slaughter houses in the country implement the same standard. They are all inspected by third party. This result in easier communication (Example is presented by “Grund certifierung gris”)
  - Professional support can be provided by manufacturers to meet organic and fair trade requirements through collaboration with local small farmers organisations. The systems enable the consumer to trace the cocoa beans what were used for production of the chocolate what they purchased. (Example is presented by “Organic chocolate for the Swiss Market”).
  - Developing standards on which such labels can be based, which provide uniform visibility so that the consumers can easy differentiate between commodities in respect for fair handling of producers. Fair Trade Labelling Organisation (FLO) developed the Fair Trade mark, which is based on two distinct sets of standards. One set is for small holders working in democratic organisation having a clear organisation structure, which ensures that all members are involved, consulted and can participate in the decision making process. The other set of standards is applied to workers and specify rules for paying decent wages, guaranteeing right to form trade unions, ensuring appropriate health and work safety standards. and provision of adequate training as necessary. In addition to the basic requirements there are recommendations, which facilitate improvements. The criteria of the standards are mostly publicly available. For all lot full traceability and segregation is

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40 More information can be found on the references in bracket in the Deliverable “D6.2: Analysis of selected experiences of best practice transparency solutions on enterprises ad food chains” of the Transparent_Food project.
Successful examples of business to business communication include:\(^{41}\):

- The implementation of a base code for ethical trading, which is based on standards of the International Labour Organisation and NGOs and Trade Marks contributed also to the discussion of the criteria. It covers issues as wages, hours of work, health and safety and the right to join free trade unions. Members can share knowledge and exchange information on the events – site along the supply chain, the retailers, the buyer and the brand owner can use the base code (Ethical Trading Initiative – ETI) to influence their suppliers to improve working conditions. Buying organisations can identify suppliers in compliance with the ETI Standards through the web-site. There are limited reports on the progress made by the companies to achieve better compliance. An impact assessment of the base code was carried out. (More information can be found at “Ethical Trading Initiative”).

- At terms of trade a good practice is used by the Fairtrade scheme, which publishes a Fairtrade Minimum Price and a FairTrade Premium price calculated specifically for the different countries. Greater transparency can be achieved by making available the minimum price actually paid to producers and the feasible premium received.

### 4.6. Conclusions

Results from the good practice inventory (Gellynck et al., 2011; project deliverable D6.2) and the “Best Practice Guide on Food Transparency” (Sebok et al 2011) indicate that a number of experiences exists which are effective in addressing transparency issues. Some of these practices are presented in the previous chapter. They vary across different domains and sub-domains (see 4.3.). However, questions remain regarding more specific characteristics of how transparency systems can

\(^{41}\) More information can be found on the references in bracket in the Deliverable “D6.2: Analysis of selected experiences of best practice transparency solutions on enterprises ad food chains” of the Transparent_Food project.
be best implemented/improved. Further, there are gaps that are not adequately addressed by practice or where lack of sufficient information leaves some questions unanswered. We refer to these as ‘research gaps’, whereby the following categories were identified:

- Developing optimal transparency systems,
- Understanding costs and benefits of transparency systems,
- Creating multi-target transparency systems,
- Identify reference systems for future scenarios.

**Developing optimal transparency systems**

The European food system is active as well on domestic markets as on international markets. In this food system, innovation is taking a leading role as precursor of competiveness, growth, welfare and well-being. Researchers as well as practitioners model the above relationship under perfect competition, whereas perfect information is one of the assumptions of perfect competition. However, within real-life contexts - especially when competition is optimized under (information) constraint – it is more realistic to consider optimal competition rather than perfect competition. Similarly, it is more realistic to consider optimal transparency systems, whereas the stakeholders have the information that they need to make decision, however full transparency is not achieved. Since transparency systems incorporate multiple stakeholders, an optimal transparency system should consider different interests (e.g. market versus public authorities) regarding transparency.

**Understanding costs and benefits of transparency systems**

Stakeholders agree that effective chain management and competiveness requires among others a good transparency system. Although, ensuring transparency throughout the food chain can also present challenges and according costs: the cost of providing information (recording, communication etc.), the cost of selecting and interpreting relevant information. These costs, of building a transparency system, have often been cited as a cause of objection.

**Creating multi-target transparency systems**

Transparency systems can focus on one target (e.g. economic target by price transparency, ecological target by carbon footprint transparency) or more targets (e.g. sustainability: environmental, economic, social concerns). Addressing more than one target does not result automatically in more transparency. On the contrary, multi-target transparency systems can be confusing during communication and difficult to evaluate. Moreover, these transparency systems are often lacking a clear focus.

**Identifying good practice transparency as reference systems for future scenarios**

Future transparency systems would have to deal with future expectations and the opportunities provided by technology in data collection, communication, and use as well as by data base services
that could complement individual data management in collection but also in communication within the chain and with consumers. Data base services could provide data bases where data of general validity have been collected in advance as a basic input for meeting transparency needs of users. While such data bases might refer to data relevant for any stage of the chain including consumers, they would not have to be communicated throughout the chain but are available wherever needed. Information technology might especially provide support in communication, in dealing with situations where information collection takes place at enterprises within the chain after the product has left the enterprise premises, a situation typical for laboratory testing, on a product’s path through the value chain (monitoring) and in communication with consumers where technologies of the Future Internet might provide new opportunities.
V CARRIERS OF TRANSPARENCY: Towards a European Tracking and Tracing Backbone

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42 Earlier version published as deliverables within the EU project Transparent_Food:
- D2.1 Specification of tracking/tracing requirements; analysis and evaluation of selected tracking/tracing solution alternatives
- D2.2 Feasibility study taking into account different ways of serving tracking/tracing needs within the sector
- D2.3 Formulation of a blueprint proposal for a European backbone solution
ABSTRACT

Existing information technology supported tracking and tracing and quality assurance systems in the food sector commonly focus on a certain production chain or cover part of a chain. On the other hand, the food sector is characterized by dynamic stakeholder relations and interconnections between different chains leading to formation of a network. Different systems in place covering subsets of stakeholders therefore have to be connected to achieve transparency. A communication backbone could offer that functionality. The following chapter describes requirements, feasibility, basic building blocks and an example use case scenario for such a tracking and tracing backbone solution.

1 Introduction

As a result of the recently growing importance of food quality and safety a number of information technology supported tracking and tracing and quality assurance systems have been developed. Most of the existing solutions focus on a certain production chain or a part of a chain. That kind of setting can currently be handled. However, changes in supply chain configurations and interconnections between chains lead to the transformation of the linear structure into a highly dynamic food sector network. To achieve appropriate transparency across the whole food sector, different tracking and tracing systems have to be interconnected. There is currently no satisfying solution available that is up to this task. The following pages give an overview of how such a solution might look like thus offering a blueprint proposal for a European Backbone Solution that provides basic and simple functionalities to enable integration of different systems.

The system proposed has to be up to certain requirements. As IT systems commonly form a certain kind of formalized representation of real world issues, these requirements can generally be derived from properties of the real world objects and topics that it is dealing with and from stakeholders’ abilities and expectations. It is thus important to get an overview of the sector structure, of systems already in place and of properties of food products that may have an influence on how certain functionalities can be technically realized. After defining the relevant terms and description of the most basic functional requirements, section 2 of this chapter goes into analysing these points in deeper detail. It is the outcome of literature review, internet and desk research, and the input of an expert working group setup specifically for creating and discussing the Backbone Solution Proposal. Statistical data on enterprise size distribution in the food sector in the European Union have been collected and evaluated. Stakeholders’ expectations have been derived from statements of the respective parties participating in a chain. Existing tracking and tracing systems have been analyzed as to what kinds of products can be handled with them, what functionalities they provide and what methods, standards and technologies they use, to find out, if there is a common ground upon which the proposed backbone solution can settle. The food products themselves and how they are processed in the chain are considered. Finally, there are certain organisational issues to be solved.

Section 3 takes a glance at feasibility of the solution, starting out with an overview on organisations which create open standards, data models and protocols for use in supply chain
management.

It continues providing a report on work conducted on assessment of existing and emerging technologies as to their capabilities with regard to the requirements found in the requirements analysis. Four aspects have been identified that have to be considered on the technical level in building a backbone infrastructure: identification of items, protocols used in communication, syntax and semantics of data exchanged. Technologies have been classified according to these aspects. A short discussion on what role the respective technologies can play in a food sector tracking and tracing backbone is given.

It turned out during the analysis, that there are other sectors with problems similar to the ones to be found in the food sector. Another subsection thus focuses on systems and common practices in use in other sectors and evaluates these with regard to their applicability in the food sector.

A proposal for the backbone solution is described in section 4. The backbone has to consider existing systems, which cover many different clusters, certain production chains or part of a chain, but never the whole food sector. Existing systems are not being replaced but interconnected by the backbone. This integration of existing systems has to be realized with a low effort and as easy as possible.

The backbone proposal will concentrate on the vertical dimension, i.e. the communication along the production chain. Each interruption of the communication line diminishes the value of the whole system. The assembled data have to cover the what (production characteristics), the how (processes), the where from (origin) and the who (actor) of each production step, based on product units.

The legal basis for the transparency blueprint proposal is Article 18 on traceability of the Regulation (EC No 178/2002) on General Food Law (European Union, 2002) and the accompanying guidance document on implementation. All food business operators, i.e. those involved in primary production, processing and distribution of food have to follow the regulations on transparency. A one-step-back, one-step-forward approach following the physical flow of the products is taken. The information which has to be delivered upon request to the competent authorities covers in the first category name and address of the supplier and the nature of the supplied products, the name and address of the customer and the nature of the delivered products, and the date of the transactions (supply and delivery). The second category comprises volume and quantity of the product, the batch number and a more detailed description. The data of the first category must be made immediately available, those of the second category as soon as reasonably practicable. According to the regulation, the operators are not compelled to establish a data link between the ingoing and outgoing products. The data have to be stored for five years, but only 6 months after delivery for products with a short shelf live. This regulation gives the minimum requirements that have to be met by each tracking and tracing solution.

In order to initiate blueprint proposal development that considers the requirements and conditions described in the requirement analysis section, recommendations on several aspects of a general transparency backbone for the food sector are made. As an illustrative example,
supporting transparency along the chicken chain with the drafted backbone system is described. The focus is on interoperable systems and openly available methodologies to achieve a solution that is affordable and widely acceptable.

2 Requirements Analysis

2.1 Sector Structure

In more conventional information technology projects, where a single customer orders a certain system or a software company creates an end user application for a broader market, requirements are largely determined by customer demands and can be derived either from an intensive dialogue with the client or market research targeting the potential users. In infrastructure and networking projects a much broader approach is necessary. There is no single customer and the end user of the technology will often never be aware that a certain infrastructure specification forms the basis of the communication upon which delivery of information relies. To be able to derive a technical and organisational architecture and the potential roles of different stakeholders, an overview of the sector with regard to basic data characterizing enterprises like size, work force etc. is necessary. A number of representative countries demonstrating different characteristics of the sector have been selected. These were: Germany, Greece, Hungary, Netherlands, Sweden and United Kingdom. Data have been obtained from the European statistics office Eurostat as available in 2010 on the internet at http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database and reflect the state of the year 2007. More recent data has been only partly available, was incomplete and thus not suited for a comparative inspection. However the newer data available indicate that – apart from commonly known trends like the one for slowly increasing farm sizes and less people working on farms per area unit – there have been no significant changes in the overall distribution of the considered parameters during the last three years. Datasets queried and evaluated in particular included:

- Key variables by size of farm (UAA), economic size of farm (ESU) and LFA status (ef_ov_kvaesa)
- Manufacturing subsections DA-DE and total manufacturing (NACE Rev.1.1 D) broken down by employment size classes - Reference year 2002 and onwards (sbs_sc_2d_dade02)
- Distributive trades broken down by employment size classes (NACE rev.1.1 G) - Reference year 2002 and onwards (sbs_sc_3ce_tr02)

For the agricultural sector – the primary production stage – the key variables are given for the farm size classes 0, 0-2 ha, 2-5 ha, 5-10 ha, 10-20 ha, 20-30 ha, 30-50 ha, 50-100 ha and >100 ha. In most countries, the number of farms is more or less evenly distributed over all these classes, but in Greece and Hungary more than ¾ of the farms are small or very small (less than 5 ha). In all countries except for Greece, the small number farms > 50 ha cover roughly half of or more than half of the utilised agricultural area. This situation is particu-larly visible in Hungary where farms with more than 100 ha contribute to nearly 70% of the utilised agricultural area. Considering the labour force the distribution over the size classes is highly variable depending on
the country. In Hungary, more than 50% of the agricultural labour force is working in farms with less than 5 ha, and nearly 15% in the largest farms, whereas in Germany and U.K., all size classes employ a significant number of work force. The economic output (measured as SGM) of the larger farms is relatively greater than that of the smaller and medium sized farms. This is not the case for Greece, where farms of the two highest size classes play almost no role neither in labour force nor in the total SGM.

Figure 1 shows that in the food and beverage manufacturing industry in the European Union as a total – representing the food processing stage – there is a large number of small enterprises (almost 80%). Even medium sized enterprises are only represented to a minor degree and very large enterprises are a minority. Considering the economic output (as turnover) or the labour force (as number of persons employed), the large enterprises account for a larger share of the market. However, roughly 20% of the overall turnover of the food industry in the EU is covered by enterprises with less than 50 employees. In this case, data are presented in aggregated form, because parts of the country-wise statistics were incomplete. However, also these numbers do not differ much between the different countries, so that layer of the food chain shows mostly constant distribution across all of Europe.

In the wholesale area of food, beverages and tobacco, the structure of the market is highly variable between the examined countries. In Sweden, about 70% of the number of wholesale enterprises fall into the lowest size class (only 1 employee), but contribute to less than 10% of the market (as total turnover). On the other hand, companies with more than 250 employees provide more than 60% of the labour force and more than 40% of the turnover while constituting only 0.3% of the total number of enterprises. In Greece, the vast majority of enterprises in this sector also has less than 10 employees, but they still contribute to about 40%
of the market. In all countries, less than 50 % of the labour force in wholesale work for enterprises with more than 250 employees.

Food and beverages are sold both in non-specialized stores (e.g. supermarkets) and in specialized stores (e.g. bakeries, groceries etc.). In all countries, the situation is vastly different between the two. It can be observed for the non-specialized stores that a few very large enterprises cover the largest share of the turnover and the labour force. This is especially the case in Germany and the United Kingdom, whereas in the other countries, small enterprises still cover between around 30 and 60 % of the market share. Most of the specialized stores for food, beverages and tobacco in all examined countries (data are missing for Greece and Sweden) have less than 20 employees, and these stores employ not only the majority of the labour force, but achieve also the largest part of the total turnover.

2.2 Stakeholder Expectations

To understand clearly the needs for tracking and tracing throughout the food chain it is highly important to discuss in depth the expectations of all involved stakeholders. Globalization of the food industry has introduced the need of various intermediates between production and consumption of goods. Almost every stakeholder now implements some kind of quality scheme in order to meet legislation needs, including traceability, and manage quality and safety of the products. All implemented protocols have been designed in order to facilitate the commerce of food establishing the minimum requirements any intermediate stakeholder would ask from all its suppliers. Therefore one of the primary expectations of all the chain node stakeholders is a common effort to be appreciated from the final consumer. In detail every stakeholder expects different information to support its activities. To most parties in the food sector tracking and tracing would be mostly useless if not answering the questions as to ‘how’, ‘when’ and ‘why’ besides to only ‘where food is produced’.

The new model of the European consumer is characterized by more specific demands on food production, a higher disposable income and increased life expectancy. Consumers are demanding convenience foods, a good quality/price relation, dietary value and confidence in safety and quality of food production. Therefore traceability information, should – apart from the exact area of production – always be accompanied by dietary factors. Also, the possibility of having access to information regarding safety of food should be provided.

Being the final destination before the consumer, stores and dealers expect due diligence from the whole food chain. Quality and safety should be guaranteed in order to create a positive consuming attitude. Retailers need to have the ability of backwards risk assessment trials for evaluation and improvement. Information should be available from every node of the chain to allow control of their creditability. Mass balance should be accompanied by information about how food is produced. No food alerts can be issued if the only item known is where it has been produced. From the stores’ and dealers’ point of view, a proactive approach to food safety is demanded that not only allows reaction to problems but also to enforce proper procedures necessary to prevent incidents from happening.

Standing in the middle of the food chain, processors and transporters have the responsibility to ensure that products reach retailers in the best possible state. Tracking and tracing for them is
crucial to manage control of raw materials risks in order to produce safe and high quality food. It is though the link with the highest difficulties in documenting all factors for the creditability of traceability. Participating in such procedures, they expect improvement of their services to be followed by easier access to the markets. Methods to facilitate documentation of all handling activities that might possibly create any risk to food safety would allow processors to feel more secure and improve their services.

Farmers, having to operate in a highly uncontrolled environment, are the ones who have to undertake the most risky practices in food production. They should be in the position to document all cultivation practices that are applied onto the quantities delivered to the next chain step. Creditable data from growers is the most crucial point for giving proof of due diligence in tracking and tracing. Being the link with low or no opportunities to apply enterprise grade information technology in order to provide data, they need to be supplied with a simple, multipurpose tool. In recent years, growers have been obliged to comply with various criteria (e.g. cross compliance, good agricultural practice, integrated crop management etc.) in order to have access to subsidies and the markets. They can be persuaded to present data if these would be collected in user friendly environments with low required investments and if tools are compatible with their existing documentation needs. Data according to farmers needs to stay strictly privacy protected but yet has to be available upon request. Farmers would be assiduous if they could gather data in an easy and secure way and when they feel confident that this information would never be used against their interest. One thing they expect is the appreciation of their contribution. Being able to be referred in the final product, at least as point of origin, would make them feel that their own production has safely been handled and good traceability practices followed. Moreover, a consistent tracking and tracing system would allow growers to check mass balance produced and delivered to the consumers.

2.3 Food Properties and Handling

IT systems for food traceability face problems distinctive of the food sector. The computerized management of traceability information must take into account several processes that food undergoes mainly in long chains. The information storing and retrieving routines have to ensure the lots tracking and allow for plausibility checks like providing the mass balance along the transformation steps from field to table. Those steps may include processes that change the material characteristics (e.g. from solid fruits to liquid juice) implying changes of units of measurement and attributes of the lots. Easier to be managed are the short chains e.g. for fresh products. In this case a strong requirement is the timing of information storing that can be enhanced by bar codes or RFID labelling.

The main kinds of properties of food itself and the processes that the food chains may include and that have an influence on design requirements of a tracking and tracing backbone solution are described in the following paragraphs.

Lots of mixing is present in most food chains. Usually at least one or two main ingredients directly traced right onto the farm, field or stable are found. Besides that, minor ingredients that come in from other chains play a role as well. Where possible the lot ID of minor ingredients is stored but in many cases (i.e. water) this is not available. For biological products or products
having a quality insurance it may be required to store a chemical analysis for a fixed timing (i.e. monthly for the water) in the system. A more complex situation arises in the restauration (canteens, fast foods etc.) where dozens of lots are assembled by the operators to be consumed in short time. Usually they have no time to measure the weight of each lot used. A pre-defined “recipe” can speed up data entry. The operator is asked to choose the recipe name and enter the lot numbers of the ingredients and the system automatically deducts a fixed quantity of the entered lots on the basis of the recipe rules. Mobile and water-proof devices are strongly required in such an environment.

Making many smaller lots from a larger lot may cause a dramatic drop of traceability precision in chains with continuing processes. In the bread or pasta chain wheat seeds are stored in large grain bins after the trucks come into the storage centre. Usually a truck load is a single lot with a single origin (field(s) of a single farm). The storage process may last for a long period and at the same time, for the same grain bin, there is an in- and outflow of material as lots are refilled and lots of seeds are sent to the mills. This leads to the problem that in case of an incident in the chain, while tracing back the lots of wheat seeds in a certain product all the farms, which put grain into the bin in a certain period of time are recognized as “origin” although their lot may not have been affected for real. A potential troubleshooting method could be to estimate the filling and emptying processes speed, to cut slices of the grain bin content covering a smaller number of origin lots (farms). Anyways, the speed is frequently irregular and due to technical problems during filling material may get mixed in the bin so the appraisal precision is low. The best practice of food safety requires a larger number of smaller grain bins and that they must be completely emptied before being filled again. The same problem is present at the mills level with flour.

A number of agricultural products enter the food chain as bulk material and the identification of lots is usually made at the stage following the harvest (i.e. collectors, food processors, cooperatives). Labelling the lots at the time of harvesting is complicated and expensive. There have been methods discussed and researched where Radio Frequency Identification (RFID) chips are used directly in the bulk material to identify lots. While this may simplify the process of lot identification in bulk materials, there are still problems: Guaranteeing even statistical distribution of the markers in the material requires them to have similar physical properties as the material itself while on the other hand allowing them to be separated out for later processing stages (e.g. before transformation of wheat to flour) requires them to have different physical properties upon which a separation can rely. Also due to current pricing of RFID technology, it is still generally used mostly only in high value added chains. However, a benefit of RFID is, that it allows for lot attributes (grower, weight, variety, location, quality...) to be recorded directly on chip in the post-harvest stage.

From the information technology point of view, enablement of plausibility checks like e.g. calculating the mass balance is a major challenge in managing the food chain. Lots of processes change the nature of the material and the related units of measure (e.g. processing from fruit to juice or again from juice to jelly). Due to respiratory losses, without any further processing only during storage, weight loss is frequent for fish, meat and fresh products in general. If heating processes are involved like cooking or frying, the situation becomes even more complex as the product processed while loosing weight at the same time may take up water or oil. Where mass
balance calculation is mandatory, as for certain quality insurance systems, transformation rate ranges have to be set for each transformation stage to prevent abuses or incorrect data. In these cases, it is required for traceability systems to be able to store process attributes that will be dynamically linked to the output lots like temperature, time or pressure that determine weight losses.

It is a commonly known characteristic of food products that they deteriorate after a certain period of time. Although other products also undergo an aging process, this problem is of special importance in the food sector, as deterioration generally happens much faster. Especially in cold chain management, where proper and uninterrupted cooling of food products during storage and transport has to be proven, this aspect plays an important role. In that case, it makes sense to capture further parameters – specifically temperature measurements – alongside of the common tracking and tracing data items described below. But also non-cooled products can deteriorate. Apart from the spatial dimension – the location where a product has been – the temporal dimension is thus an important parameter to capture.

From the point of view of the consumer, a number of immaterial properties of food may be important that can not be grasped by physical properties or are not at all or not easily measurable. This includes for example expected food processing according to certain methods due to ethical or religious convictions (e. g. kosher, halal), ethical and social aspects like guarantees concerning proper treatment of trade partners and employees (fair trade, fair wage) or statements about organic growing and processing. Traceability depth, lot and process attributes to be stored are affected by these immaterial aspects of the final product.

This is one of the reasons, why IT systems currently are tailored for a specific food chain and predefined frameworks are difficult to establish. From the consumers’ point of view, the “processed tomato” food chain doesn’t really exist. Consumers demand for the additional information about immaterial properties that a specific final product is expected to have to be traced. This situation has developed over the past few years. At the very beginning tracking and tracing IT systems were adopted for food safety purposes only and they were asked to manage just the products recall. Now, they can play a crucial role to support the marketing of quality products.

2.4 Existing Tracking and Tracing Systems

As the system specification to be developed is meant to integrate existing systems into a larger network backbone, it is necessary to take a look at the products currently available on the market of information technology supported tracking and tracing systems. It is of special importance to gain an overview of the networking facilities that are already implemented in products as methods and standards used there may serve to find a smallest common denominator that provides a low entry barrier to adoption of a new backbone network. An analysis conducted in the Transparent Food project also showed that there are a number of systems out there that provide an especially well designed solution to certain aspects of the problem and which thus may serve as an inspiration for the backbone solution specification.

A framework of analysis with regard to the following aspects has been setup:

- Provider and product names, general description and information on contacts, in-
formation sources etc.

- Scope of application, application area, supply chain monitoring start and end point, integrated levels of supply chain, stakeholders
- Interfaces, networking, information technology standards in use, organisation of data storage (centralized/decentralized)
- Quality standards to which the product adheres and for which the product can provide support in management of the chain
- Necessary investments

Oriented on that framework, information for all listed solution providers using material commonly available in publications, leaflets and on the websites of the respective companies has been collected. To deepen the understanding of certain aspects, together with the invitation to a system providers working group meeting, a questionnaire has been sent out and responses have been analysed. Although return of questionnaires was only at around 10% of the total number of system providers looked at, a number of interesting results with regard to the requirements of the backbone solution could be derived.

Most of the system providers analysed are specialized in the agrifood sector. Others offer systems to track and trace all kinds of items and provide a certain system or program for food. A number of enterprises focus on other sectors where similar demands exist, e. g. Kezzler and rFXcel that are concentrating on the pharmaceutical industry, or Savi Technology that offers solutions for aerospace, defense, civil agencies and natural resources.

Most companies are situated in Europe or in the USA, but there are also several system providers located in Thailand, Malaysia, South Africa, and Tanzania.

For a number of enterprises, the operational status at the time of the analysis was unclear. The German enterprise Transparent Goods was closed in 2008. The French organisation Setrabio became insolvent. The current status of support for their product Tracerbio is unknown from the information sources we had access to. Furthermore, it was not possible to collect adequate information about a traceability system for shrimp and seafood called ThaiTraceShrimp. It is provided by the Department of Fisheries in the Ministry of Agriculture and Cooperatives in Thailand. Neither the corresponding website nor other contact information was available. Several systems cover multiple food products. Systems with two possible fields of application have been assigned to the more important sector. Systems with multiple fields of application have been ranked among “food in general”. Thus, the high number of available systems in this category can be explained (see figure 2). Nearly all systems cover the whole food supply chain from the farm to the point of sale. It becomes more and more common that consumers themselves can trace back their purchases with the help of product codes via the internet. HarvestMark by YottaMark, Foodtag by Lyngsoe Systems and several other traceability systems offer this possibility.

The field of food in general is covered by solutions such as ChainPoint or Q-Tracing by ChainFood from The Netherlands, String by Historic Futures from UK, Foodtag by Lyngsoe Systems from Denmark and many more.
Concerning meat the Irish company identiGEN’s solution DNA TraceBack can be mentioned which uses genetic identification to trace the source of meat products through the entire supply chain. The German HI-Tier Database focuses on cattle and includes first of all farmers, but also veterinarians and slaughterhouses. Matiq from Norway offers another solution to trace meat and meat products.

Fruit and vegetables can be traced with the Dutch system IQMO fruit & agro, web4trace by the German provider Winckel, and QualiTrack from South Africa.

Special solutions to trace fish and seafood are OpsSmart and ProductionSmart (FXAgroup, Thailand) and a tracking system provided by Trace Register, USA.

ARGE Kaisergetreide from Austria represents a quality program for grain. The program Tracerbio by the former organisation Setrablo dealt with organic grain mainly in France.

The American rXcel and the Norwegian Kezzler create solutions for the pharmaceutical industry. The US company Savi Technology created highly developed traceability solutions for aerospace, defence, civil agencies and natural resources.

Standards and accompanying applications are offered by the EPCglobal network. It provides basic technologies for tracking and tracing like RFID and barcoding identification standards and services and directories to query data and was designed to support all kinds of products. It has however to be noted, that not all processing events occurring in the food chain, especially events, in which a product does undergo transformations, are supported by EPCIS. We will come back to EPCIS as a standard in the feasibility assessment section.
Every system provides some kind of data export or import functionality. XML is mentioned as being applied as a data format by seven out of 39 investigated providers (18%). The rest of the providers either do not work with XML or no detailed information could be found.

EPC/GS1 is the most common IT standard among the reviewed providers. It is used by 20 of the 39 selected providers (52%). It is however important to note that EPCglobal standards are layered (Traub, 2013) and the identification technology layers can be implemented independently from service layers like EPCIS or ONS. There was no information available as to what degree the providers support these different layers. Considering the fact, that EPCIS is also based on XML, also the use of XML as such may be much higher than in only the 18% of systems mentioned above. Nineteen providers (48%) either do not support EPC/GS1 or give no statement about it.

Several companies also mention use of other IT standards than XML and EPC/GS1. AltaVia from Italy, for example, uses ASCII text files for exchange. SQL is applied for manipulating data and running queries (Pernec from Malaysia, AltaVia from Italy). The German enterprise Axway works with EDI, however it is unclear, if they support any standardized incantation like EDIFACT or if they used the term just to mention the fact that they can interchange data with other systems. TDS and TDT are applied by EPCglobal. Fab4minds from Austria and Kezzler from Norway both mention the use of the Java 2 Enterprise Edition platform as a standard applied, which refers more to a programming language than to an interface.

With regard to data management and storage either a central approach with a single database at the core of the system or a decentralized approach with distributed interconnected databases is possible. Sixteen of the regarded tracking and tracing systems (41%) apply the central data management approach, only four systems (10%) use a decentralized system. However, a large number of enterprises (49%) do not specify their mode of data handling in publications commonly available.

Only fifteen providers explicitly give information about the quality standards and programs their traceability systems are compatible with on their websites. Most of them support multiple standards, for example, HACCP and ISO in combination. HACCP, the EU General Food Law Regulation 178/2002 (European Union, 2002), ISO 9001 (International Standards Organization, 2008a) and 22.000 (International Standards Organization, 2005), BRC (British Retail Council), GlobalGAP, and IFS (International Food Standard) are the most frequently used standards for quality management in the systems evaluated.

Most systems do not require expensive investments. A couple of systems are internet based applications or databases and therefore an internet connection is necessary. Others require the purchase of specific software. The user can either buy this software or rent it for a monthly fee that depends on the amount of transactions. Furthermore, a sign up or license fee to join the systems is quite common. For a few systems special hardware is inevitable. For the use of fab4minds’ Bio Stock Manager a special chip card reader is needed. YottaMark’s HarvestMark requires an extra label printer. Kezzler does not only sell its own software system but also compatible marking and coding systems. The Tanzanian Traceability-T supplies the necessary software, hardware, and capturing devices for participants. Several companies such as RedLine Solutions offer training courses, like seminars and webinars, to instruct employees in handling
the systems.

The questionnaires provided a more detailed view on certain aspects of systems in place and showed where systems differed and where there were similarities. All systems allowed for web based access. Using HTTP to access data from the outside is an option in all of the systems, so on the protocol level, this may be the common ground to settle on. Encrypting network traffic using SSL and/or TLS is possible, some of the systems even support more sophisticated business-to-business authentication using client certificates alongside the more common server certificates known from SSL-secured websites. Formalized service descriptions like WSDL seem to be used only to a minor degree.

Concerning the IT environment, even within the low sample size given by the few questionnaires returned, a broad diversity can be observed. As for operating systems and web server software used, Linux with Apache and Microsoft Windows in combination with Microsoft’s Internet Information Server (IIS) were mentioned. Each of the companies that returned their questionnaire implemented their solution in a different programming language (PHP, Java, VB.Net, Perl). Persistent data storage is done using the database systems MySQL, Microsoft SQL Server or PostgreSQL. It is to be expected that this diversity is still even much larger when regarding the whole sector of tracking and tracing system providers. This observed diversity poses certain restrictions on the methods and standards that may be used in a backbone solution. Specifically, only easily portable and system independent technologies should be applied.

For the purpose of identification, the providers supported a variety of schemes and methods. RFID and bar coding were mentioned for tagging, both in standardized (EAN/EPC) and in non-standardized variants.

A striking fact was that none of the providers uses a standardized data dictionary (e. g. for product names) and each of them is laying out their database records according to their own semantic view of the sector. The reason may be that the initiatives in the food sector in this area are still relatively young. The lack of a common vocabulary that can be used may turn out as a challenge to integration of different systems in a backbone solution.

3 Tracking and Tracing Backbone Feasibility

3.1 Organisational Resources

A certain factor for success is how stakeholders can be made to cooperate and to what degree already existing initiatives for standardisation and cooperative system (components) development and implementation can be involved. Various organisations provide standards or directories for data in supply chain management and in the food and agricultural sector. Both public and governmental bodies and private associations are involved in this work. This section gives a rough overview. Description of standards and service provided by these organisations follow below.

GS1 is a global non-profit association with over 100 member organisations. GS1 has developed standards for identification such as key numbers (e.g. GTIN), data carriers (bar codes, EPC) and
communication (e.g. EANCOM). The development process (Global Standards Management Process) involves working groups with experts delegates from member companies. The responsibility of the national member organisations is the allocation of unique numbers to member companies and providing training and support. The member companies have to pay a fee for obtaining the GS1 company prefix.

A subsidy of GS1 is EPCglobal. Its subscribers are end-users such as manufacturers and solution providers such as hard- and software companies. EPCglobal is leading the development of industry-driven standards for the Electronic Product Code (EPC) to support the use of Radio Frequency Identification (RFID). It assigns EPC Managers Numbers, delivers certification of application and provides other services. Member companies can participate in the development of standards.

Another not-for-profit organisation is OASIS (Organization for the Advancement of Structured Information Standards). Members are government agencies, software providers and industry groups. Standards developed by OASIS are for example the Open Document Format for Office Applications and ebXML. The specifications are all royalty-free.

Also involved in the development of ebXML is the UN/CEFACT (United Nations Centre for Trade Facilitation and Electronic Business). It also produced the UN/EDIFACT standard. UN/CEFACT provides recommendations for trade facilitations, electronic business standards and technical specifications. Members are governments, intergovernmental organisations, NGOs, chambers of commerce, and companies from the private sector. The permanent groups which develop standards, specifications and guidelines are open to technical experts in the respective fields.

The UN/CEFACT has been established by the UNECE, the United nations Economic Commission for Europe. The major aim of the UNECE is to promote pan-European economic integration. The Working Party on Agricultural Quality Standards developed a series of standards and recommendations on food products such as meat.

On EU level, several organisations are involved in the standardisation process. The European Food Safety Authority (EFSA) operates separately from the European Commission, European Parliament and EU Member States and is governed by an independent Management Board, but is funded by the EU budget. The EFSA collects analytical measurement data for the presence of harmful or beneficial chemical substances in food and feed from a variety of providers such as national authorities, laboratories, research institutes etc. A standard sample description for food and is used. The standard sample description document was developed by the Technical Working Group on Data Collection (TWG-DC).

Other efforts come from limited term projects. EuroFIR (European Food Information Resource) was a five-year Network of Excellence funded by the European Commission’s Research Directorate General under the "Food Quality and Safety Priority" of the Sixth Framework Programme for Research and Technological Development. It contributed to the cataloguing of food products.

On a national level, various governmental bodies such as ministries, agencies, federal state offices produce standards for data exchange in the food sector. In Germany for example, the governmental agency for consumer protection and food safety (BVL) is coordinating the creation of coding catalogues and mechanisms for data exchange for food control purposes.
Apart from those stakeholders providing domain specific standards, there are a number of organizations involved in providing basic and generic information technology standards. The most notable ones with this regard include the World Wide Web Consortium (W3C) offering a multitude of recommendations for data and information exchange across the Internet directed to humans and machines, the Internet Engineering Task Force (IETF) focusing more on the lower level protocols and machine-machine interaction or the International Standards Organization (ISO) Joint Technical Committee 1 (JTC1) serving as a normalization organisation in information technology.

3.2 Protocol

As a preliminary necessity of data exchange, there has to be some mechanism how stakeholders initiate communication and how they can request information from each other, in other words, they need a protocol how to talk to each other. This is not yet describing the content that they exchange but rather providing very basic functionality for negotiation, requests, responses and termination of a communication process. There are several methods and standards of differing level of complexity and functionality available for that task.

Electronic data interchange (EDI) enables companies to exchange business documents in a standard format. One standard for EDI is the UN/EDIFACT (United Nations Electronic Data Interchange for Administration, Commerce and Transport), which has been developed by the UN/CEFACT (United Nations Centre for Trade Facilitation and Electronic Business) since the eighties. A subset of this standard is EANCOM, which has less optional elements and is easier to handle. The EDIFACT standard lists more than 200 message types, each with a six character name (e.g. ORDER for purchase order message). A message has a hierarchical structure and is a collection of segments, which are characterized by a three character tag and conditional or mandatory data elements. Single characters are used as field separators and terminators. Multiple messages can be grouped together in an interchange and are wrapped into an electronic envelope also consisting of segments. The syntax of EDIFACT is very condensed and not meant to be human readable.

EDIFACT messages can be sent from one company to another using any available communication protocol. In the beginning of EDI, dedicated lines or modems where commonly used. Another way of message exchange are Value Added Networks (VAN) realized by provider companies which simply act as an electronic mail box. The internet protocols (SMTP, HTTP(S), FTP) are also used. Based on HTTP is the specification AS2, which uses signing, encryption and MDN (Message Disposition Notification, the ability to provide return receipts). It is widely used in the retail sector. For smaller enterprises without own EDI infrastructure who only have to transmit smaller amounts of data, web based applications (WebEDI) are available.

A newer standard for electronic business is ebXML (Electronic Business using eXtensible Markup Language). It is maintained by the UN/CEFACT and by OASIS (Organization for the Advancement of Structured Information Standards). The first version was already issued in May 2001, since then a number of its specifications have become ISO standards. ebXML includes five types of specifications: on business processes (Dubray et al., 2006), on collaboration protocols and agreements (OASIS ebXML CPP/A Technical Committee, 2002), on messaging services (ebMS;
Wenzel, 2007) on registries and repositories (Fuger et al. 2005a and 2005b) and on core data components. All definitions of the data exchanged over ebXML are stored in an ebXML registry as XML documents. The data pools are managed by service providers or major suppliers. ebMS is based on SOAP (Mitra and Lafon, 2007), the underlying communication protocol is usually HTTP. SOAP Version 1.2 is a lightweight protocol intended for exchanging structured information in a decentralized, distributed environment. "Part 1: Messaging Framework" defines, using XML technologies, an extensible messaging framework containing a message construct that can be exchanged over a variety of underlying protocols.

EPCIS (Electronic Product Code Information Service; EPCglobal Inc., 2007) is a standard for the exchange of data on product movement. It is meant to be complementary to EDI. Each time an electronic product code is read, an event is generated which answers the questions about what (product identified by manufacturing data e.g. EPC number), where (location of enterprise, position in supply chain), when (time of event) and why (status, process step). The events are stored in a database, the EPCIS repository, usually hosted by the manufacturer. The repository has a capture interface for storing the events and a query interface for retrieval of event data. An ONS (Object Name Service) provides a lookup service which delivers the address (URL) of an EPCIS repository for a given EPC. Other EPC Discovery services which serve as a search engine for EPCIS are currently under development. The transfer of data via the capture interface is via HTTP, the query interface uses SOAP, XML over AS2 and XML over HTTP(S). All message protocols must be able to use authentication and authorization. A complete free and open source implementation of the EPCIS standard specification including Repository as well as Query and Capture clients has been developed by a team located mainly at the ETH Zurich/Switzerland.

A detailed guidance document on data exchange has been published by the EFSA in 2010 for their purposes (EFSA, 2010b). The main requirement was the simplicity of the protocol and its easy implementation. The transmission of data might be either by manual posting of files (upload to a web application) or by automatic transmission. As file formats, Microsoft Excel files or CSV files (comma separated values) are permitted for a limited period only, as these formats are more susceptible to errors and automatic validation is more demanding. The preferred format for the data is XML.

The Message Exchange Protocol describes the exchange of messages between sender (e.g. member state authorities) and receiver (the EFSA): the data message, the MRN message (Message Receipt Notification) and the acknowledgement message. The transport layer for the physical exchange of the messages can be FTP or by web services. To meet security requirements, the sender software has to provide an user identification and password and to use a secure internet protocol such as FTP through SSL.

In a large and uncontrolled network, designing a robust protocol can quickly become a challenge. Using the paradigm of message orientation prevalent in networked systems in the 80s and 90s of the previous century in such a setting often leads to an unmaintainable mess of messages and method calls that have to be implemented by each stakeholder individually to be able to interoperate. Without knowledge of the exact implementation on the other end, no communication is possible. Criticism on EDI and EDIFACT mostly circles around this issue. The World Wide Web Consortium’s standards around message oriented web services like SOAP
(Mitra et al., 2007; Gudgin et al., 2007a and 2007b) and WSDL (Chinnici et al., 2007a and 2007b) are nowadays seen as a failure in large scale deployment for this reason also by many prominent researchers and developers in the area (see e.g. [http://www.infoworld.com/d/developer-world/sun-technologist-soap-stack-failure-415?source=fssr](http://www.infoworld.com/d/developer-world/sun-technologist-soap-stack-failure-415?source=fssr)).

Concerning the tracking and tracing backbone envisioned, focusing on these technologies can quickly lead to a very complex undertaking considering the number of stakeholders involved and the dynamic nature of the food network. For that reason, it is proposed to instead follow a RESTful paradigm (Fielding, 2000; Richardson et al., 2007), in which method calls are restricted to the minimum set that is necessary to retrieve and post data. Nature and content of the data is of no relevance on the protocol layer. Only if the data is to be interpreted later on, knowledge of semantics is required. Experiences from system providers present in the working group mentioned above indicate that this approach is feasible.

### 3.3 Syntax

When exchanging data, both communication partners (sender and receiver) have to agree not only on a protocol for data exchange, but also on syntax. The syntax describes the structure of the data. Technically, the data fields and how they can be identified and separated out (“tokenized”) for further processing have to be defined.

The most common language for data structuring is currently XML (eXtensible Markup Language; Bray et al., 2008). XML files are text files, where each data field is marked with a tag pair. Hierarchical, tree-like structures can be implemented by nesting the tags accordingly. Crosslinks among tree elements are possible using either the ID/IDREF mechanism (within the same document) or XLink (across different documents; DeRose et al., 2010). XML files can accommodate almost every language of the world by using one of the Unicode Universal Character sets, most commonly UTF-8. As described below, XML is used in major supply chain, eBussiness and Food Sector standards. A variety of tools and libraries for almost every programming language is available. Most of the system providers analyzed in deliverable 2.1 of this work package explicitly state in their documentation that they support either XML or standards based on XML like EPCiS. In general, XML is thus a natural choice for implementing at least a part of the backbone solution components. Data structures can be specified using so-called schema languages like XML Schema (Fallside et al., 2004; Thompson et al., 2004; Biron et al., 2004) or RelaxNG (Clark et al., 2001). That way fields that may be contained in documents and their relation to each other can be restricted to a valid set that can be checked upon reading or writing files.

XML has received criticism for being too verbose and blowing up simple and small datasets and thus produces relatively large files. Therefore, alternatives have been devised, that allow for a more compact representation and quicker reading, parsing and serialization. Recently, JSON (Crockford, 2006) catches increasing attention, as it allows for easy integration of web browser application frontends into an infrastructure of services targeted at machine to machine communication. XML files can easily be converted into JSON syntax using freely available tools. A JSON schema implementation similar in functionality to XML schema has been proposed (Zyp, 2010), it is however not yet an accepted IETF standard. JSON is well suited to the requirements...
of transporting a large number of small data packages and of creating tracking and tracing helper components for commodity hardware that arise in implementing the backbone solution. In fact, already a number of system providers can offer support for JSON syntax.

For ebXML, an implementation of the Core Components Technical Specification (Crawford, 2009) in its earlier version 2.0 is the Universal Business Language (UBL; Bosak et al. 2006). This standard data format has been defined by OASIS and provides XML schemas for business documents (e.g. order, invoice, etc.).

EPCIS (EPCglobal Inc., 2007) also uses XML as data format. The messages used are centered around the concept of an “event”. To describe events, four event types exist, which share some common attributes, but also have specific data fields. The types are Object Event (events during the lifetime of an object), Aggregation Event (describing the physical aggregation of children objects to a parent, e.g. cases to pallet), Quantity Object and Transaction Object. Figure 3 gives an overview of the underlying data model.

In agriculture, agroXML is striving for creating an XML-based data format for documentation in quality assurance in agriculture. The focus is much broader than only tracking and tracing. It can serve to record accompanying data of most of the processes and practices in arable farming, like soil tillage, fertilization and pest control. Subsets can be of use in the tracking and tracing backbone. For example, a common issue are changes in field geometry due to reorganisation. Therefore, if track and trace is to be implemented on the field level, the traceability reference units (TRUs) to be regarded in a system change as well. Documenting these changes is possible using agroXML.
3.4 Semantics

As mentioned above, there is currently no standardized or even system-independent data dictionary in use by any of the systems evaluated in depth. However, for efficient data exchange it is necessary to be as clear as possible among the stakeholders involved about the meaning of terms and data items used without going through the hassle of bilateral agreements (which is infeasible in a global network). This may involve even more than a data dictionary. Formalized semantics in the sense of having the subjects of discourse and their relations defined also in machine readable form are required to facilitate machine-based interpretation of data packets. This work can start out as simple as defining and describing the core tracking and tracing data items described below and then gradually be extended into a “backpack” of information. Such an undertaking also has the potential of enhancing transparency by providing navigational aids and novel views onto existing data sets and thus increasing the level of understanding of and knowledge on relations and patterns in information.
One approach is the use of controlled vocabularies. Within these, a restricted number of allowed terms is defined. This avoids confusion and allows for the grouping of data and the comparability of data from different origins. Each term might have allocated a key number consisting of digits and in some cases also of letters, such as “E121”.

In the past, stakeholders producing such vocabularies mostly used their own “home-grown” systems of keeping terms and relations, often using relational database technology. The drawback of this approach was that vocabularies were difficult to exchange and use across different domains and systems. Only recently, with the advent of the semantic web and a higher demand for global information exchange standards for vocabularies have gained increasing attention. Notable technologies in use include the Resource Description Framework (RDF; Manola et al., 2004; Klyne et al., 2004; Hayes et al., 2004), RDF Schema (Brickley et al., 2004) and the Simple Knowledge Organization System (SKOS; Miles et al., 2009) by the World Wide Web Consortium. They provide methods to describe terms and relations among them and to build statements describing certain resources (objects, documents, processes etc.). A URI (Berners-Lee et al., 1998; Berners-Lee et al. 2005) is assigned to each term and relation thus providing globally unique identification of concepts. Based upon these vocabularies, data and information can be encoded in a flexible and extensible way. Data missing in a set can often be derived using formal logics and information given elsewhere so that a networked knowledge base can be implemented. This approach would lend itself well to the backpack of information attached to a track and trace base data set described below. For this to work out, closer alignment of a number of existing vocabularies in the food and agricultural sector is required.

In the food sector, also several classification systems have been established. Two main types can be identified: hierarchical classification and faceted classification. Hierarchical classification systems have a tree like structure where each term has a “belongs to” relationship to a parent term with a broader meaning, e.g. “apple” belongs to “fruit”, “fruit” belongs to “plant products”.

One of the institutions that uses a hierarchical classification system is the EFSA, the European Food Safety Authority. The EFSA collects data from the EU member states, the European Commission, the industry etc. on food consumption, the incidence and prevalence of biological risks, and occurrence of contaminants and chemical residues. A standard sample description for food and feed is used, which is composed of a list of standardized data elements (definition and structure), controlled terminologies and validation rules (EFSA, 2010a). The target is to harmonize the collection of analytical measurement data on food and feed. Controlled terminologies for all parameters of the analysis have been established, e.g. for the analytical method, the country of origin, the result etc. The product code describing the product under analysis is a hierarchical tree with 376 terms such as “Lettuce” or “Goat liver”, thereof 34 root terms such as “Citrus fruit”, “Baby food”. Each term is coded with a 9-digit product code, e.g. “P0120110A”. Another list of terms describes the processes applied to the product or any indexed ingredient.

Another hierarchical classification is used by the German Federal Office of Consumer Protection and Food Safety (Bundesamt für Verbraucherschutz und Lebensmittelsicherheit, BVL). The automatic transfer of data from the federal states to the BVL on the analysis of food for the official food monitoring uses a fixed set of codes. For the description of the food and other
samples, a 6-digit code is used, for example “312107: Kiwi juice”, grouped under “312100: Juice from exotic fruits”. This system allows for a large number of data (7 million in 2007) and a fast retrieval of data with a minimal effort. It has therefore found a high acceptance. Its origin is in the early nineties, when datasets had to be as small as possible due to limited transfer rates. Currently a project to establish a new data exchange system at the BVL is under way. The basic principles such as the uniform coding, standardized formats, central management of the catalogues and validation checks before the release of data are kept. The new system will be based on a faceted classification. A basic list of food stuffs is supplemented by a catalogue of facets describing multiple characteristics of the food. This faceted catalogue is based on LanguaL.

A faceted classification is a multihierarchical classification, where each item is described by a number of characteristics, the “facets”. LanguaL (Møller et al., 2009) is a food description thesaurus which uses a faceted classification. Each food is described by a set of standard, controlled terms chosen from facets characteristic of the nutritional and/or hygienic quality of a food, as for example the biological origin, the methods of cooking and conservation, and technological treatments. Table 1 gives an overview of available facets.

The facet term lists are hierarchically structured. The work on LanguaL started in the late 1970’s in the USA. In recent years, the EuroFIR (European Food Information Resource), an EU funded project has indexed a large number foods. LanguaL is now multilingual with approximately 70000 terms (English, German, French etc.). The main focus is on food consumption and food composition.

The advantage of a faceted classification is a greater flexibility regarding the integration of new properties. In a hierarchical classification system, a new code has to be created when a new type of a known product appears, for example a new key number has to be created if kiwi peel appeared on the market, additionally to kiwi fruit, kiwi juice etc. In a faceted classification, only a new combination of existing terms needs to be used in this case.

<table>
<thead>
<tr>
<th>Facet</th>
<th>Name</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facet A</td>
<td>PRODUCT TYPE</td>
<td>SAUSAGE OR SIMILAR MEAT PRODUCT (EUROFIR) [A0798]</td>
</tr>
<tr>
<td>Facet B</td>
<td>FOOD SOURCE</td>
<td>HIPPopotamus [B2130]</td>
</tr>
<tr>
<td>Facet C</td>
<td>PART OF PLANT OR ANIMAL</td>
<td>ROOT, TUBER OR BULB, WITHOUT PEEL [C0240]</td>
</tr>
<tr>
<td>Facet E</td>
<td>PHYSICAL STATE, SHAPE OR FORM</td>
<td>DIVIDED INTO SEGMENTS OR WEDGES [E0107]</td>
</tr>
<tr>
<td>Facet F</td>
<td>EXTENT OF HEAT TREATMENT</td>
<td>HEAT-TREATED, MULTIPLE COMPONENTS, DIFFERENT DEGREES OF TREATMENT [F0023]</td>
</tr>
<tr>
<td>Facet G</td>
<td>COOKING METHOD</td>
<td>DEEP-FRIED [G0029]</td>
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<tr>
<td>Facet H</td>
<td>TREATMENT APPLIED</td>
<td>OLIGOSACCHARIDE ADDED [H0240]</td>
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<td>Facet J</td>
<td>PRESERVATION METHOD</td>
<td>PASTEURIZED BY HEAT BEFORE FILLING [J0159]</td>
</tr>
<tr>
<td>Facet K</td>
<td>PACKING MEDIUM</td>
<td>PACKED IN GRAVY OR SAUCE, VEGETABLE [K0037]</td>
</tr>
<tr>
<td>Facet M</td>
<td>CONTAINER OR WRAPPING</td>
<td>ALUMINUM TUBE, TOP LINED WITH FOIL [M0170]</td>
</tr>
<tr>
<td>Facet N</td>
<td>FOOD CONTACT SURFACE</td>
<td>BEVERAGE CAN ENAMEL, NONCARBONATED BEVERAGE [N0012]</td>
</tr>
<tr>
<td>Facet P</td>
<td>CONSUMER GROUP/DIETARY USE/LABEL CLAIM</td>
<td>VERY LOW SODIUM FOOD [P0153]</td>
</tr>
</tbody>
</table>
Using a system of key numbers for the applied terms reduces the amount of data to be transferred and stored. This was of greater importance in former years, when transfer rates and file storage place were much smaller than they are now. It also restricts the length of the codes, which facilitates automatic data processing.

In order to streamline the flow of information throughout the supply chain and to provide a standard for use between buyer and seller in the meat industry, UNECE (United Nations Economic Commission for Europe) Working Party on Agricultural Quality Standards defined the “UNECE STANDARD Bovine Carcasses and Cuts” (UNECE, 2004). Similar standards exist for caprine, chicken, duck, llama/alpaca (UNECE, 2006), ovine, porcine and turkey meat (UNECE, 2009). Each standard gives detailed specifications to identify cutting lines including colour photographs and diagrams. Also, minimum requirements for meat are formulated. All data are coded in a 20-digit string. For available data fields see table 2.

The UNECE purchase specification code has been assigned the GS1 application identifier (7002) to be used in conjunction with a Global Trade Item Number (GTIN) and represented in the GS1-128 bar code symbology. This allows the UNECE code information to be included in GS1-128 bar code symbols on shipping containers along with other product information.

Multiple other lists and controlled catalogues of food stuffs are in current use. In Germany for example there exists also the “Bundeslebensmittelschlüssel” (Federal key for food) which uses a 7-digit coding system for food consumption surveys (not for tracking purposes), and the “Stoffliste des Bundes und der Bundesländer” (List of substances for the use of the Federal Government and the federal states) which gives a list of plant products used for the legal distinction between drugs and food.

### Table 2.

Data fields in the UNECE standard for bovine meat

<table>
<thead>
<tr>
<th>Data field</th>
<th>Category</th>
<th>Example</th>
<th>Example Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Species</td>
<td>Bovine (Beef)</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>Product/cut</td>
<td>Tenderloin</td>
<td>2150</td>
</tr>
<tr>
<td>3</td>
<td>Not used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Refrigeration</td>
<td>Deep frozen</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Category</td>
<td>Heifer</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Production system</td>
<td>Organic</td>
<td>3</td>
</tr>
<tr>
<td>7a</td>
<td>Feeding system</td>
<td>Grain fed</td>
<td>1</td>
</tr>
<tr>
<td>7b</td>
<td>Not used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Slaughter system</td>
<td>Halal</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>Post slaughter system</td>
<td>Specified between buyer and seller</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Fat thickness</td>
<td>3 mm maximum</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>Bovine quality</td>
<td>Company standards</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>Weight range</td>
<td>Not specified</td>
<td>0</td>
</tr>
</tbody>
</table>
The AGROVOC thesaurus by the Food and Agricultural Organization of the United Nations (FAO) is nowadays the most comprehensive multilingual thesaurus and vocabulary for agriculture. Originally, it was devised for indexing of literature, but it is increasingly used also in facilitating knowledge sharing and exchange through electronic media and machine-readable data formats. It contains approximately 30000 so-called concepts (terms) that are at least in part available in more than 30 languages. The vocabulary is provided in standard RDF and SKOS and concepts are identified by URIs. Therefore, it is easy to reference these concepts or create mappings to other vocabularies. Apart from several agricultural ontology relations defined by a small agrontology, AGROVOC uses common thesauri relationships like “broader term”, “narrower term”, “related term” etc. that are also used in LanguaL. By conversion to RDF/SKOS, LanguaL could therefore probably relatively easily be interconnected with AGROVOC thus forming a larger, networked Agrifood-Vocabulary.

3.5 Identification

No tracking and tracing can be setup without unique identification of the objects to be tracked, the so called TRUs. Identification systems, especially when identifiers are to be distributed among a potentially unlimited number of stakeholders and valid globally, require a certain organizational framework to be in place. In the past, in closed systems under the control of a single entity, identifier handling was mostly left to the databases used to implement the system. Sequences setup provided serial numbers and control that there are no duplications was done by uniqueness constraints and checks done by program logic. Such a built-in, mathematically formalized mechanism can not easily be put to work in a distributed manner. However, there are methods and mechanisms in place to allow for management of globally unique identifier assignment. Commonly used ones involve a hierarchical setup, where from a number of stakeholders each one takes responsibility for a certain value space. Examples for this approach are best known from the internet, e. g. the organisation of IP addresses into subnets, within which free assignment is possible or the hierarchical structure of the DNS with top level domains being managed by country-wide organisations and host name assignments that can be done by stakeholders having registered a certain domain name.

One common method used in web services – also for tracking and tracing systems like e. g. EPCIS (EPGlobal Inc., 2007, page 23) – is the use of Uniform Resource Identifiers (URIs, Berners-Lee et al., 1998; Berners-Lee et al. 2005) not only for addressing the service but also for identifying the objects to be tracked or the stakeholders being involved. Their syntax is standardized and an exhaustion of unique identifiers is practically impossible. A hierarchical distribution of responsibility for certain value spaces is provided for the URI subset of Uniform Resource Locators (URLs) by the domain name system registration procedures and management practices are in place and well understood. Apart from URLs, there is another subclass of URIs, the URN. Both of them have different advantages and disadvantages, e. g. the URN being persistent, but non-resolvable while the URL is non-persistent but resolvable. URIs can be connected to a dereferencing mechanism: The identifier can directly be used to retrieve information or data on
a certain object. The most commonly known application of this mechanism is the retrieval of websites in a web browser using its URL. The EPC Information Services make use of this facility as well by allowing both URLs and URNs and providing standardized means of how a URI is constructed from a bar code or RFID scan. Using this URI, a lookup can follow resulting in an information request for the respective object with the tag on it. All in all, a standardized dereferencing mechanism allows for interconnected information sets by specifying further links in documents available at a certain URI (c.f. anchors in the Hypertext Markup Language, HTML).

In a tracking and tracing system this cross linking can provide a very simple and powerful mechanism to build up distributed data storage along a chain that can be traversed by clients. Using directly resolvable URIs as identifiers has the advantage that web data requests can be directly encoded into the identifier and information can be directly requested without doing further preprocessing. By using two-dimensional barcodes, it is even possible to directly encode URLs and thus load data on the tagged object via the internet onto mobile equipment without further user input.

It currently seems that there is a huge potential in these kinds of technologies and there are a number of promising implementations. However, further work is required to find out how these methods may be used in a system-independent tracking and tracing backbone solution.

Identification of items in web services and software as described above however only delivers half of the solution. The other half is identifying real world objects and making the link between them and the data stored on them in IT systems. The common method for setting up the link is applying unique keys to the objects themselves by tagging them using sticky barcode tags, RFID chips or simple manual numbering. For tracking and tracing purposes, identification by labelling or tagging of goods plays a crucial role. Unique identifiers across the whole chain simplify handling significantly, as otherwise, tags would have to be replaced upon arrival at the respective following party. Labels can be either bulk-wise, such as the EAN-code (European Article Number), batch numbers and expiry dates on various products, or on an individual basis. Individual tagging has been realized in the identification of animals, but e.g. also on pharmaceuticals for fraud detection purposes.

Identification of farm animals is mandatory in the EU for bovine animals (cattle), pigs, sheep and goats, and for equine animals (horses, donkeys, etc.). The objective is the localisation and tracing for veterinary purposes and ensuring food safety. As equine animals are of a minor importance in the food chain (<1% in all of the European countries except for Italy), they are not considered here. For poultry, identification is not required on a single animal basis. For pigs, identification has to be by ear tags or tattoos. A register has to be kept on each holding, and the number of animals has to be recorded during movements.

For sheep and goats, electronic tagging is mandatory for all animals born after 2009-12-31, a register is kept on each holding. Currently, movements have to be recorded for each group of animals, and a database is kept at national level. For cattle, the system consists also of similar elements: individual identification, maintaining a register on each holding (farm, market etc.), cattle-passports (recording of each individual movement), a computerised database at national level. The rules on the individual traceability of bovine animals were already laid down in 1997 as a consequence of the BSE crisis. Identification of cattle is usually by double ear tags on each
animal, electronic identification is currently under development. This individual identification and recording of each movement allows tracking each animal from birth to the slaughterhouse.

Electronic identification is usually realized by RFID (Radio Frequency Identification). A passive transponder receives energy and responds with the information stored in its IC (integrated circuit). Different frequencies are in use. The LF-range (< 135 kHz) is the only one suitable for animal identification as only this signal can penetrate through living tissue. The transponders are usually applied as electronic ear tags or as bolus. The bolus is swallowed by ruminants and then stays in the rumen. Injectable microchips are also available, but they are not recommended for animals for slaughter, because the post slaughter recovery is difficult. Readers can be either stationary or handheld. The use of RFID for animal identification is standardised by the ISO norms 11784 and 11785 at worldwide level (International Standards Organization, 1996a; International Standards Organization 1996b). The code stored in the transponder contains the country code, a 12 digit identification code and several additional fields. Manufacturer coded transponders are also available. The transponders can only store numbers, but no alpha numeric coding. The use of numbering schemes for the identification number is not recommended because this would leave many numbers unused. Each animal might be assigned one number, which is then readable on the ear tag and also encoded in the RFID tag, but both tags can also carry two independent numbers which then have to be linked in a data base.

Electronic identification of animals might also have additional advantages as it can be used for dairy or cattle and veal automation. However, the equipment currently used for these purposes such as neck belt transponders and the matching are not suitable to track individual animals. To control the feeding process, only ear tags are feasible, as the presence of the head in the feeding trough has to be registered. Individual identification can help to group the animals into weight classes or to link breeding information to weight outcome.

RFID technology is also widely used in logistics and the supply chain management and in many other business areas. In logistics, the Electronic Product Code (EPC) is used. The EPC is stored in the RFID transponder and consists of a header, which classifies the code type, and codes for the EPC manager (the GS1 member, who issued the code, e.g. the manufacturer), the object class (e.g. an article reference) and a serial number. Product codes are for example the SGTIN (Serialized Global Trade Item Number), the SSCC (Serial Shipping Container Code) or the GRAI (Global Returnable Asset Item). In the retail sector, RFID has never reached full coverage. The US supermarket and store corporation Wal-Mart required that their vendors place RFID tags on all shipments in 2005, but this rule seems to have never been totally enforced. One of the disadvantages of tagging individual items in the retail business are environmental concerns such as the consumption of resources (metals) and the difficulties for the recycling of tagged packaging.

The most commonly used code in the retail business is the European Article Number (EAN), also known as GTIN (Global Trade Item Number). The EAN standards are defined by GS1. The number has 13 or 8 digits (for smaller items). It is usually printed as a bar code on the sales packaging. Bar codes are more suitable for quick and safe automatic reading for example by scanner at a point of sale then human readable characters. The EAN 13 consists of a company prefix (7 to 9 digits) which includes the country prefix of the issuing GS1 member organisation and an
individual item reference (3 to 5 digits, depending on the length of the prefix). The last digit is a single checksum digit. A licence fee has to be paid to obtain the company prefix from the GS1.

Another bar code standard is the GS1-128 standard. It is a subset of the Code128 symbology used to code data into a bar code. The main use is in the logistics sector. Its maximum capacity is up to 48 characters, the maximum length of the bar code must not exceed 165 mm. The GS1-128 code contains a list of data fields, each identified by an two to four digit application identifier. Data fields of variable length must be terminated by a function code. The data given describe the product or the shipping such as the SSCC or the lot number etc. However, usually no individual serial number is coded in the GS1-128. For labelling of meat, the “Reference to Source Entity” can identify the individual ear tag number of the animal, the UN/ECE Meat Carcasses and cuts classification can describe the product, the Country of Initial Processing gives the country of fattening etc. This standard is therefore suitable for tracking and tracing purposes in the meat industry.

Related to bar codes is the two dimensional DataMatrix code (GS1, 2010b). It consists of black and white fields in a rectangular grid, which each code for one bit. The symbol also contains a L-shaped finder pattern, the code data itself and some error correction codewords. Each DataMatrix symbol can code for up to 2335 alphanumeric characters. The GS1 has defined a standard, then called GS1 DataMatrix. The Symbology Identifier (the first three characters transmitted by the scanner indicating symbology type) ‘[d2’ specifies that the symbol read is a GS1 DataMatrix symbol. The symbol can be read as a concatenation of data elements such as GTIN, expiration date, serial number etc. with a fixed or variable length.

![DataMatrix Code](image.png)

Figure 4. Examples for an EAN 13 bar code (left) and a GS1 DataMatrix code (right)

Each data element string is identified by a two to four digit application identifier at its start position. To read a DataMatrix code, a camera based scanner has to be used, but even many modern mobile phones are capable of reading such a code. However, the GS1 DataMatrix is not intended for reading at a retail point of sale.

### 3.6 State-of-the-Art in other Industries

#### 3.6.1 Product Identification in the Pharmaceutical Sector

The purpose of product identification in the pharmaceutical industry is mainly the prevention of
fraud and counterfeiting. To assure the origin of a product from a pharmaceutical manufacturer who guarantees for the safety of the ingredients, the production process and the final product, the smallest sales unit is marked with an identification code. This code is then recorded and can be used to document the position of the product in the supply chain using tracking and tracing procedures. The main goal is to ensure the consumer safety, but there are also billing and tax requirements.

Legal regulations and standards still differ on a national base. In Turkey, relevant legislation is currently being implemented. Each sales unit has to be marked with a unique serial number. The patient submits this package to the insurance company to receive a refund.

In California, the ePedigree law (“Electronic California Prescription Drug Pedigree Law”) obliges all pharmacies to sell prescription drugs only with a record documenting every step in the supply chain from the manufacturer to the retailer. The law was originally planned to apply in 2011 but has been postponed to 2015.

In Italy, all pharmaceutical packages have to be individually labelled by prestamped labels (“Bollini”).

The French CIP (Club Inter-Pharmaceutic) has recommended usage of a 13 character code for the product number starting in 2011. Individual serial numbers for each unit are not intended to be used.

Recommendations on product identification have been made by the IFAH (International Federation for Animal Health) and by the EFPIA (European Federation of Pharmaceutical Industries and Associations).

The data printed on the each package or other smallest sales unit, e.g. blister, bottle, etc. may contain the batch number, the GTIN (Global Trade Item Number), the date of production, the data of expiry, and a serial number. The serial number is unique and non-sequential. Data is usually coded into a 2D-DataMatrix code following the GS1 standard. The code is printed on the unit or a pre-printed label is applied. Each package is then optically inspected and the serial number is recorded in a database. During the packaging process from carton to pallet, a hierarchy of serial numbers is built. Finally all transactions within the supply chain down to the pharmacy and the end customer can be recorded in a database kept by the manufacturer.

In comparison to what can be achieved with product coding in more common retail products and the food sector, practices applied in the pharmacy sector allow for a much higher tracking and tracing precision due to unique serial numbering of single smallest sales unit. In the pharma sector, it is commonly easy to justify such an approach by the benefits created. In the food sector however, due to the lower value of the tracked goods high costs may not pay off.

### 3.6.2 Electronic Record Procedure for Waste in Germany

In Germany, the management of all hazardous wastes has to be recorded on the way from producer to carrier and disposer. Since 1st of April 2010, these records have to be kept electronically. The goal is to enforce the product responsibility of the producer and to ensure a
well-regulated disposal.

For all transactions, electronic documents are generated. Starting 1st of February 2011, these documents have to be electronically signed using a qualified electronic signature. This involves the use of a signature card for each person involved and a card reader. A central coordination site ("Zentrale Koordinierungsstelle Abfall") organizes the exchange of data between the waste management companies and the responsible authorities. The companies also exchange the documents between each other. Each company must also keep an electronic register of all transactions.

The interface for all data exchange is defined in XML schemas. Tag names in this XML dialect are in German to avoid misunderstandings of technical terms due to translation into English. While on a national level, this approach is feasible, it hints at the importance of multilingual electronic thesauri in international data exchange. The type of waste is recorded as given in the List of Wastes established by the European Commission. This catalogue classifies all waste types generated in the EU. It is a six digit code, where the first two digits determine the source such as a specific industry branch (e.g. 02 WASTES FROM AGRICULTURAL, HORTICULTURAL, HUNTING, FISHING AND AQUACULTURAL PRIMARY PRODUCTION, FOOD PREPARATION AND PROCESSING), the next two a production process (e.g. 02 03 Wastes from fruit, vegetables, cereals, edible oils, cocoa, coffee and tobacco preparation and processing; tobacco processing; conserve production) and the last two digits the waste type (02 03 04 – materials unsuitable for consumption or processing).

Usually, for this electronic record procedure, a suitable software application is used. Various products are offered on the market. Web based access to the central coordination site is available free of charge. The electronic record procedure is meant to be applied only within Germany, export to other states is not covered. The reason for this restriction to national law is that all hazardous waste must be disposed in the same country where it was produced anyways.

4 Tracking and Tracing Backbone Solution Blueprint Proposal

4.1 Architecture

Each stakeholder is responsible to store and deliver the data produced by him. Data for each product are provided by the holding that delivered the product to the next step in the production chain. There is no central server storing all data, but a network of computers connected to each other by the data links to the previous and the next node in the production chain as required by the one-step-back one-step-forward approach. “Node” is in this context used as a general term describing a step in the production chain where a transformation of change of ownership of the material takes place, e.g. a farm, a retail store etc. The architecture proposed is thus not a single hardware backbone, but a network of many distributed servers all using the same standards and processing the same core data.

Each node will need to be able to store and retrieve the data for each product, and to deliver them to a client over the internet. Addressing unique product item data sets is achieved by using URLs (Uniform Resource Locators). They consist of the name by which the server is addressed in
the internet (Berners-Lee et al., 1998; Berners-Lee et al. 2005) and an additional path component leading to single data sets. URLs can easily be automatically derived by attaching identifiers to each other to build hierarchical paths. So either the URLs or identifier components to build the respective path have to be provided on the label of each product. The URL is thus part of the agent dataset as described in the data model. The architecture follows a “pull” approach, where information is collected on demand in accordance with the EU Regulation (EC No 178/2002, European Union, 2002) on General Food Law.

As has been shown, the agricultural and food sector is characterized by many small enterprises that can not maintain a suitable infrastructure on their own. Their data management could be handled by a service provider, (“software as a service”) e.g. an internet provider, a farmers association or another organisation. The data for the individual holding will then be completely accessible to the responsible person by a web application or web services. However the reliability and data rate of internet connections might be an issue especially for farmers and smaller enterprises. To send data to the service provider, an internet browser or a mobile device such as smartphone might be used. For this group of stakeholders the use and extension of already working systems is very important. For those data which must be delivered according to legal requirements the availability of low cost solutions is essential. To ensure accessibility and long-term availability of data also in case of transfer to another provider or software product, procedures and tools used for encoding and – if necessary – encrypting data need to follow open standards.

A central issue is data security and authorisation and authentication of the users. Confidential data on the production process from which a company’s intellectual property like recipes could be derived (e.g. the exact amounts of ingredients) must not be generally visible to the public. All data must be protected from subsequent manipulation. The producer of the data retains sovereignty; he is responsible for the data and keeps control over them. Therefore, there is a clear separation of concerns and responsibilities between the publisher and the consumer of information in the tracking and tracing backbone use case setting. The basic architecture can thus be restricted to dealing with mechanisms of getting information. Methods to insert and update datasets can individually be adapted to circumstances valid for the respective stakeholders.

For authentication and authorisation, well established and efficient tools and procedures are available. To be able to implement and use these properly however, a clear view of necessary user roles and access policies is necessary. The use of a Public Key Infrastructure (PKI) is proposed. The term “infrastructure” in this context describes organisation, software and hardware. Organisational matters are a key issue. The core of a PKI is a Certification Authority (CA) which signs and in some cases also manages and distributes the keys for authentication and authorisation. The certificate owners then use their keys to identify themselves and for electronic signatures. Each user owns a private key e.g. for generating a signature. The public key matching this private key is openly available to all stakeholders and proves the authenticity of the signature. The institution issuing the key signatures must be trustworthy. The CA can authorize other CAs to provide keys, for example a service provider for his customers. A real world example of a PKI is the method of key usage for SSL/TLS-enabled Onlinebanking or other eBusiness-sites on the internet using HTTPS. An unresolved issue is currently how users can be
personally identified (in contrast to identifying the machines communicating). Several technical solutions exist, but none of them has found overall acceptance. For ensuring confidential transmission of the data, Transport Layer Security (TLS) and its predecessor, Secure Sockets Layer (SSL) offer the vast majority of functionality needed for this use case. TLS encrypts the data transmitted over the internet, so that only the sender and the authorized receiver of the message can read it. As data packages can – if users are authenticated beforehand – be built upon individual requirements for the user role they belong to and communication is always one-to-one, encryption on the transport layer level is sufficient and no separate encryption on the content level necessary.

Apart from a PKI with one or several trusted third party CAs, solutions based on a web of trust or other decentralized approaches exist (e. g. PGP, OAuth). They have found widespread acceptance in personal communication. However, while – at least for the case of PGP – being equally secure than the trusted third party approach, they are currently not that relevant for business communication.

### 4.2 Labelling and Identification

All statements and claims related to the transparency requirements or expectations are the same for all material of a Traceability Reference Unit (TRU). To access the data produced at a node of the production chain, information on the lot and its source has to be given on the label of each TRU. In a tracking and tracing backbone, this will at least be a data source address, optionally an additional company code and a unique lot identifier.

To identify the agent involved in a specific node of the production chain, a unique name has to be given. For larger holdings, this is identical to the data source address and can be the domain name of the server where the tracking and tracing data are stored and retrieved. This domain name is part of the URL. The domain name is linked to an IP address within the internet by the Domain Name System (DNS). Each domain name is unique within the top level domain (“de”, “com”, etc.). The registration procedure for the domain names differs for different top level domains.

For smaller enterprises, the data source address may link to a service provider. Therefore, an additional unique number for each agent (i. e. slaughterhouse, farm, etc.) within the scope of the service provider has to be given.

In Germany, all holdings keeping farm animals (cattle, pigs, sheep, poultry etc.) have to register at the local veterinary office (Bundesrepublik Deutschland, 2010). The farm is then provided with a 12-digit registration number (2 digits: federal state, 3: administrative district, 3: municipality, 4: ID). Similar regulations apply in other countries, but the format of the registration number might be different.

Another system for numbering is the GLN (Global Location Number). The GLN is a 13-digit number and is composed of the company prefix, a location reference and a check digit (see e. g. Traub, 2011). The company prefix is assigned to the holding by a GS1 member organisation, for which a fee has to be paid (currently minimum 230,- € one-time registration fee, plus 150,- € annual fee in Germany). The interpretation of the Agent-ID and delivery of the respective correct information is responsibility of the service provider who manages a certain URL space.
The ID of the lot and/or TRU might be any arbitrary number or alphanumerical string as long as it is unique in combination with the previously mentioned components.

This information is needed to build an URL to retrieve the tracking and tracing data from an internet based server and to link the collected data to the physically existing material. For deriving this real service address, facilities like the Object Name Service (ONS) can be used. However, for future implementations, it is recommended to directly provide the complete URL, mitigating the need of querying additional directory service components or to construct it from the items above facilitating the information retrieval process. All identifiers should be given in a human readable and a machine readable format on the label or shipping document.

For the machine readable label, a DataMatrix or similar 2-dimensional barcode is recommended. The format has been standardized by ISO/IEC 16022 and ISO/IEC TR 24720 (International Standards Organization, 2006; International Standards Organization, 2008b), it is public domain. The GS1 DataMatrix standard uses the GS1 symbology, indicated by the function code FNC1 at the beginning of the code. This standard can be easily integrated into the system proposed here.

The information capacity of the DataMatrix code is sufficient to store the information needed and described above. Products for generating and printing the codes are easily available and many camera based devices including mobile phones can read these labels. No specialized hardware is needed as would be the case for example with RFID.

### 4.3 Data Model

Tracking and tracing requires the collection of data at each node of the production chain. It can be distinguished between basic data which cover the minimum requirements of the one-step-back one-step-forward approach and additional data which can be considered as a backpack.

Basic data are the ID of each TRU, the product ID, its source, the date and time when it was obtained from this source, and the customer or target of the product including date and time of delivery to this target. How a TRU is defined depends upon the product and the intended tracking and tracing depth with regard to certain properties. Usually it will be a lot, which is a batch of the product characterized by a common uniform production process in a narrow timeframe. It can be as small as a single beef animal or as large as tons of wheat harvested from a field. Such a lot might be divided and parts of it delivered to multiple customers. This has to be considered in the data model which must allow storing multiple targets and delivery timestamps for each lot.
The data model proposed in this blueprint uses an entity “TRU” which has the basic data attached to it as properties. In a particular process, more data will be stored (the “backpack”). These data are grouped into further attached entities. In an object-oriented design, TRUs could be implemented as classes with subclasses inheriting the basic data set and extending it with additional properties allowing for the backpack data to be stored (figure 5).

Each TRU originates from a production process. The entity “Process” will not only store the links to the incoming products such as feed stuff in animal rearing, but it will have specific parameters for the production process attached. These are highly dependent on the type of process. Some of them are mandatory to collect in a specific production chain, such as the temperature time course of deep-frozen products to proof safe storage conditions. Other data are important for plausibility checks such as quantities used for a mass balance or relevant for immaterial properties, e.g. the tracking of the origin from organic farming (figure 6).

“Supplier” is the entity delivering a TRU; “Destination” is the customers to which a TRU is delivered. Both are subclasses of “Agent” which describes an entity acting on the market, such as a farmer, a retail store etc. The data needed to identify such a business holding, e.g. address, unique ID, are properties of “Agent”.

The visibility of the data to a particular user, e.g. the general public, a responsible person from an authorized public administration body etc. depends on the type of data and the respective production chain. There are however basic data attached to “TRU”, “Process”, “Supplier” and “Destination” that are legally required and must be made accessible to authorized persons. Additional data is made visible depending on policies applicable within a specific production chain.
chain.

The model covers all data required to answer the questions about the what (production characteristics), the how (processes), the where from (source) and the who (agent) as described earlier.

4.4 Syntax

The data transmitted to and from the server must have a structure which has to be agreed upon between sender and receiver before any communication can start. It should be standardized to at least a certain level to allow data exchange between all possible partners. The syntax of the data for tracking and tracing should be human-readable for debugging, error tracking and long-term technology-independent archival purposes as well as be parsable by a computer program to allow for further automatic processing, e.g. finding the next step in the production chain or to permit to track to the common primary source of several products. Using so-called content negotiation, the format to be used can be negotiated between sender and client. In technical terms, the HTTP-request sent by the client to the server contains a header giving a list of preferred formats that will be understood by the client. The responding server will then send the data in an appropriate format.

Several formats that are both human-readable and machine readable can be recommended for implementation. One is XML (eXtensible Markup Language), which was published as an open standard first in 1996 for the representation of data structures and marking up documents (Bray et al., 2004). To be more convenient for human readers, XML can be transformed using technologies like XSLT (Kay, 2007) which is integrated in a number of common web browsers.

Another format is JSON (JavaScript Object Notation) which is also an open standard. It is mainly
designated for efficient data exchange in interactive web applications and less verbose than XML (Crockford, 2006). JSON can be processed by JavaScript in the web browser of the client.

Finally, HTML together with RDFa (Adida et al., 2012) attributes is proposed as a data transmission format. HTML is designed to display text and other material on web pages and was already specified in 1991. RDFa provides additional attributes to make HTML machine-readable by giving hints on the meaning of web page elements. To achieve this, the elements are labelled by using existing vocabularies. RDFa can thus serve to unify human and machine interfaces.

Multiple programming languages allow generating each of the formats proposed here. Each of the formats proposed here fits well to the data model described above and allows extending it with further elements. Also, each of the formats works with the architecture and protocol proposed above.

4.5 Semantics

Each element of the data model has a specific meaning which must be fixed and communicated to all stakeholders. The terms used should map to a standardised controlled vocabulary. This approach is consistent with the strategy to reuse existing systems whenever possible and to extend them if necessary.

To describe each food product and its ingredients, the use of the food description framework LanguaL (Møller and Ireland, 2009) is proposed. LanguaL is a multilingual thesaural system where each code points to a term in different languages. It can therefore be easily used in an international setting, e.g. for cross-border trade. The classification of food according to LanguaL also allows to derive its nutritional characteristics. LanguaL is perfectly suitable for computer processing.

For the earlier steps of the production chain and for non-food products, Agrovoc (Food and Agriculture Organization of the United Nations, 1999) can be used. Agrovoc is a multilingual thesaurus for agriculture and related fields and has originally been published in print form as well but is recently focusing on electronic provision using semantic web technologies. The terms are organized in a hierarchical scheme, synonyms point to the same concept. The use of the controlled vocabulary of Agrovoc therefore ensures the unambiguity of agricultural terms.

However, the available taxonomies do not cover all terms needed in the food production chain and a need to add more items will rise. Development of a networked ontology of food products, which will not only cover more concepts, but also represents the semantic relationship between terms is desirable.

The GTIN (Global Trade Item Number) managed by GS1 can also be used for product classification (see e.g. Traub, 2011). It includes a company prefix and a serial number. As the serial number is an arbitrary number issued by the company, it has no information about the product on its own, i.e. without querying the issuing company. The GTIN is therefore useful for the identification of a product or a TRU, but does not give a description of the product. At the end of this section, within a chicken chain scenario, a number of examples will be given to illustrate usage of the mentioned vocabularies and classification schemes.
4.6 Protocol

The protocol used to access the tracking and tracing data over the internet has to handle a large number of participants, where the actual number is unknown. Only a minimum set of preconditions concerning the message exchange should be needed to retrieve and post data. Therefore, a RESTful architecture is recommended, that serves these requirements best. REST is an acronym for “Representational State Transfer” and describes a software architecture for distributed systems (Fielding, 2000; Richardson and Ruby, 2007).

REST is based upon the assumption, that all functionalities of interaction between agents in a network can be realized by using only four method calls following the so-called CRUD (Create-Read-Update-Delete) pattern. This corresponds e. g. also to the design of SQL with its INSERT, SELECT, UPDATE and DELETE keywords. The Hypertext Transfer Protocol (HTTP), the protocol which the World Wide Web uses for transfer of data to a web browser, is based on similar method calls giving the possibility to issue a PUT, GET, POST and DELETE against a certain server. REST can thus be based on resources distributed over the web being manipulated using HTTP. Each resource can be unambiguously identified by a URL (Uniform Resource Locator), by which the resource can be queried. However, multiple alternative URLs might lead to the same resource or a URL can lead to a collection of resources (e.g. a list of products). URL path design should be harmonized, well worked-out and agreed upon between service consumer and producer. Therefore, a standardisation effort of the URL design used in a backbone will be useful.

Resources in this use case are created by the producer and need not be changeable from the outside point of view of a stakeholder querying information. In case of an error, the wrong resource has to be deleted and a new resource is created by the node responsible for issuing a certain TRU. Complex version management can be avoided by a clear separation of concerns between stakeholders and does not need to be exposed in the external interface. Each time the same URL is queried, the same object is referenced. This permanency facilitates use of data to data consumers, as the external interface only has to provide means to retrieve information. Web accessible updating is only needed in the case, that a food producer uses the services of a provider to manage his data. Then the user interface for remote data entry might need to allow for creation and updating of data. The question how data is exactly initially entered is irrelevant to the method how data is later on published and therefore does not have to be considered in a basic tracking and tracing backbone. There are however a number of interesting issues connected to this question especially with regard to the participation of small and medium sized enterprises in such an operational model. For example, the protocol must allow sending the data upon request, so that no permanent internet connection is required and technological support for automation would be helpful.

In contrast to the REST protocol proposed here for tracking and tracing in the agricultural and food sector, business protocols such as EPCIS, UN/CEFACT and EDIFACT follow a different approach using large sets of individual method (function) calls using e. g. the SOAP technology. This protocol has been proposed for exchanging structured information between multiple systems. However, it needs a detailed knowledge of the exact implementation on the other end and is therefore applicable mostly to an intranet where all clients are known. The mentioned
business protocols are also more suited to business information exchange and specific to very special and restrictively regulated processes like ordering, delivery and invoicing or other business transactions. The different goals make them difficult to extend for the specific needs of the food sectors and they do not scale to a more generic approach of retrieving potentially unlimited and distributed data sets on a certain object.

4.7 Example Scenario: Transparency Along the Entire Chicken Chain

The use case “Transparency along the entire chicken chain” is described in detail in Chapter 4 of this book. This section thus provides only a rough outline of the non-technical matters of the case.

To document the origin of broilers, each step of the production chain is recorded. All relevant data are transferred to the next step in the production chain. This procedure guarantees that the origin of the product, its raw material and ingredients is under proper control.

The production chain of broiler chicken involves multiple relevant parties. Some of the parties are linked to more than one step of the production chain, e.g. feed production is relevant both for parent couple breeding and broiler breeding. The chain ends with the retail sale of the (optionally processed) broiler meat to the final customer.

In this use case, the TRU for each step is the lot, which consists of products made of chickens from the breeding plant with the same batch code. For each lot, the lot number, information on its origin, its quantity and certain quality parameters are transferred to the next step in the chain by paper intake registers and delivery notes. At each production step (e.g. slaughtering), the data are mapped to the lot number of the next step by paper logbooks or local computer based production documentation. Finally, the consumer label carries the name of the product, the lot number containing a reference to the broiler farm and house, the date of processing, and the “Use by” date.

The linkage between a product and its ingoing products (e.g. a chicken and its feed) in this model is therefore given by the process.

In the data model, all data belonging together are grouped in an entity. Figure 7 depicts all process and TRU entities needed in the chicken chain. The TRUs are given in blue, the processes in yellow.

Each TRU has two categories of data, first core data which are required for each TRU independent of the production step, and second backpack data which give additional information and are specific for this TRU.
In the object-oriented design example given in figure 8, “FeedMix”, “BroilerLot” and “ChickenLot” are TRUs. From a technical perspective, they are child classes of the parent class “TRU” and inherit its properties. “BroilerBreeding” is a child class of “Process”; “Source” and “Target” are child classes of “Agent”. In each case, the core data are stored in the parent class, whereas the additional data, which can be regarded as backpack, belong to the child class. Inheritance is symbolized by an empty arrow. Each product is associated with a process, each process with several incoming TRUs.

The meaning of the values of each data field (semantics), has to be agreed upon by all stakeholders. This involves that the terms used are all covered by a controlled vocabulary.
The product of each step in the production chain must have an unambiguous name. It is proposed to use the classification system of LanguaL (Møller and Ireland, 2009) for food products, thus in this chain for the outcome of the last steps. According to this, the product which is delivered to the consumer after slaughtering of the broilers and retail without further processing can be classified as shown in the example in Table 3.

Figure 8. Classes that may be used in an object-oriented design setup

Other values for the fields E to M will apply for a final product when the production step “Further processing” is included in the chain.

The products of earlier steps of the production chain, where non-food but rather primary agricultural products have to be described such as a feed, other raw material or live animals, can be classified by terms of the Agrovoc Thesaurus (Food and Agriculture Organization of the United Nations, 1999). Table 4 shows example term codes.

Table 3.
Classification example for the chicken chain according to LanguaL

<table>
<thead>
<tr>
<th>Facet</th>
<th>Term</th>
<th>Facet Term Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Product type</td>
<td>Poultry meat</td>
<td>A0795</td>
</tr>
</tbody>
</table>
Backpack data might include information on the physical quantities such as the quantity of a lot. For each quantity, a unit and a value have to be given to avoid confusion. To specify the quantity of a lot, the approach used for example in the GS1-128 standard can be useful. Each data field consists of an application identifier and a value. The description of the application identifier includes the unit (GS1, 2010a). Examples for quantity descriptors applicable in the chicken chain are given below.

### Table 4.
AGROVOC terms used in the chicken chain

<table>
<thead>
<tr>
<th>Label</th>
<th>Term Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hens</td>
<td>11525</td>
</tr>
<tr>
<td>Cocks</td>
<td>24006</td>
</tr>
<tr>
<td>Broiler chickens</td>
<td>9435</td>
</tr>
<tr>
<td>Food cereals</td>
<td>2828</td>
</tr>
</tbody>
</table>

### Table 5.
GS1 application identifiers that can be used in the chicken chain

<table>
<thead>
<tr>
<th>Application identifier</th>
<th>Description</th>
<th>Data Format</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Quantity Each</td>
<td></td>
<td>BroilerLot</td>
</tr>
<tr>
<td>310y</td>
<td>Product Net Weight in kg</td>
<td>6 digits</td>
<td>FeedMix</td>
</tr>
</tbody>
</table>

A label on each TRU or each retail package has to give at least the following basic data in human readable form:

- Name, address and identifier of the source (holding where this product comes from)
- Product ID
- TRU-ID

This will allow URL construction and mapping the material to the data and permit subsequent retrieval of the data over the internet. Directly providing the URL is an option that will further facilitate this process.

The example given here illustrates how a client can retrieve detailed data for a lot of broilers. The client uses the data given on the delivery note of the product, which allows to build or
directly gives him an URL. Issuing a HTTP GET-request on this URL initiates information retrieval. In this example, the server is maintained by a service provider, who manages the data of many food producing companies who are each too small to support their own infrastructure. The returned data are both machine and human readable. The client can now request more detailed data by sending a second HTTP message using the process ID given as a second URL in the first data package to identify the data. The server answers by sending the process data. These data contains a link to the producer of the feed mix, which is again the URL of a server, which is now maintained by the feed mix producer as the source agent of the relevant product. The client can now contact this server to retrieve the data. In such a way, a client can navigate through a complex delivery network and retrieve data on a complete supply chain. For stakeholders providing information, it suffices to follow the one-step-up/one-step-down approach as mandated by the EC legislation.

![Sequence of events in data retrieval](image)

**Figure 9. Sequence of events in data retrieval**

5 Conclusions

Overall, the analysis shows a broad diversity of enterprise size distribution characteristics across countries and across different stages of the food chain. While the larger enterprises commonly are small in numbers but contribute a relatively large part to the economic outcome and to the percentage of bound labour force, small enterprises still play a major role in various stages of the food sector, especially in primary production and specialized retail stores. With this regard, the sector differs from other industries like e. g. the electronics sector, where there are almost no small enterprises present in the supply chain or the automotive sector, where there are lots of medium sized enterprises in the pre-production parts deliverer stage of the chain and a small number of very large corporate enterprises doing final assembly. The picture given of the sector has a number of consequences as to requirements of the envisioned backbone solution to achieve sector-wide transparency. First of all, small scale enterprises will neither be able to run their own information technology department nor be able to afford running their own systems at
expensive IT outsourcing companies. The solution to this problem may be to deliver access to the tracking and tracing solution backbone by mechanisms like “software as a service” (SAAS), where external providers offer a common interface to a large number of clients, usually using the Internet. However, the financial outcome of running SAAS depends on a certain critical mass of clients that may be interested in participating from the beginning on. Therefore, currently most companies providing these kinds of services to individuals and enterprises of all size classes focus on very general infrastructure services like common storage (e. g. Amazon S3, google Drive) or Email (various enterprise class webmail providers). An important aspect to consider when evaluating the feasibility of that kind of solution is thus the question of a suitable business model and future legal boundary conditions. For future directions in providing a backbone solution however, these questions will have to be dealt with.

Another issue with regard to providing access to the backbone to small and medium sized enterprises as software as a service is the question of internet connectivity. Although broadband internet connectivity is becoming more and more common in every country in the EU, the percentage of reliable internet connections is constantly decreasing. This comes from the fact that on the one hand more connectivity options today rely on wireless technology (UMTS, satellite modems etc.) – especially in rural areas – and on the other hand there is an increasing number of connections without having throughput and availability guaranteed by either technical measures or an appropriate service level agreements (cf. DSL lines with variable bit rates vs. various incarnations of ISDN multiplexed lines like E1-E5 with guaranteed bit rates).

Thought has also to be given on how to deal with temporary outages. Available internet service architecture design patterns allow for simple caching of requests. While certainly not suited to overcome long-term connectivity outages, it has to be evaluated if these mechanisms can at least be used to allow for bridging short term gaps.

Another aspect to consider is the large number of potential participants to the network. Solutions available in other industries like e. g. RosettaNet in the electronics industry which is based on web services built around ebXML are thus not easily transferable to the food sector, as – due to their design as RPC services – they will not scale to stakeholder numbers that large. Methods and technologies used in a backbone will have to accommodate on the one hand large amounts of smaller data packages and on the other hand a large number of small stakeholders.

Stakeholders expectations and needs and also motivations to use a tracking and tracing system differ depending on their position in the chain. A demand that obviously has to be considered in designing the backbone solution is the possibility to trace backwards and forwards. Having access to more information than just bare tracking and tracing data is a common requirement to all stakeholders.

The special properties of food and processing methods mentioned have implications on the setup of a tracking and tracing backbone. While a number of problems can be avoided by following certain handling and processing best practices, certain mixing and division steps of lots during processing are unavoidable in the food sector. In a distributed system without centralized storage, it may be best to deal with this aspect in setup of identifier handling. A hierarchical scheme supporting formation of sub-lot numbers based on the original lot number for divisions may work in certain cases but leads to clumsy and large identifiers upon mixing of lots. Rather
dynamic tracing is possible, when identifiers serve also as network addresses that can be resolved to retrieve further information through e. g. web services. In such a system, a chain or even more complex networks can be navigated by simply resolving a lot identifier, querying the identifiers of the comprising lots and – resolving these again – following the resulting links to the next service providing further information on composition of lots. Systems following that kind of approach are used e. g. in the pharmacy sector. However, to implement tracking functionality, this method requires nevertheless a mechanism for querying the most recent position of a certain object in the chain from outside of the chain. Further analysis of different processing scenarios is required to evaluate the suitability of this scheme for the food sector.

A basic information set to enable tracking and tracing can easily be agreed upon. The data items necessary have been identified by a working group of system providers as being:

- **Who:** The company that shipped a certain good
- **When:** shipping date and time information
- **What:** A product code identifying the product
- **Lot number:** A number identifying a certain lot of a product. The necessity to provide a lot number also serves as an incentive for good management practice, as this will lead to shorter lists of lot numbers in case of a tracing request.

Further attributes either to the product itself or other information stored elsewhere may be necessary to allow for additional controls using plausibility checks (mass balance), checks for other parameters (proof of uninterrupted cold chain) or safety proofs (pesticide applications, additives) and for chains to be separated based on scope (e. g. organic/non-organic, fair trade/standard trade system). Therefore, it is required to be able to attach a flexible “backpack” of additional information to the information set depicted above.

To keep the information set small and suited on the one hand to be transferred across slow links, and on the other hand to be captured for lots of smaller items in mass production without blowing up stakeholders databases, it may be necessary to capture some of the data in central directories. This lends itself especially to the “who” data item given above. The EPCglobal standards framework provides a standard for such a service called the ONS (Object Name Service) that may serve as a repository of additional stakeholder data.

Acceptance of an interoperability and networking solution for heterogenous systems also depends to a large degree upon the people having to implement an interface feeling comfortable with it. They will if it comes as close as possible to their own technical environment and fits the tools and methods they use well. On the other hand, to be able to accommodate all potential partners with their diverse information technology background and environment, a number of compromises will have to be made with regard to the methods used. It is a crucial factor for success to find a set of standards and methods that are up to the task but at the same time simple, clear and generic enough to be accepted by everybody. This choice is to a large degree influenced by broad support and good integration into toolsets used by the different companies. The entry barrier may be lowered further by taking care that, where reuse of a number of standards is possible, a set of orthogonal specifications without unnecessary duplication of functionalities is chosen.
As diverse as the food sector structure is the market of existing tracking and tracing solutions. Web technologies seem to have found their way into systems, but methods used differ. Nevertheless, there are a number of commonalities among systems. Dealing with HTTP-requests and applying textual data formats like XML or similar alternatives for data exchange obviously pose no problem at all to any of the providers who returned questionnaires. On the one hand, GS1 standards are broadly used in the sector, on the other hand however the degree of support varies and providers are reluctant to accept the standard as the one and only solution for several reasons including pricing policy as well as over-engineered service interfaces and incompleteness with regard to the issues and problems of the food sector.

The central database paradigm is widespread in comparison to a distributed storage approach. The centralized approach has a number of advantages in implementation of a tracking and tracing system like e. g. facilitating integrity checks. However, database system interfaces may not map as easily into a networked infrastructure as systems, that by design support a distributed approach.

Data from a chain are used by different stakeholders in different scopes (e. g. organic production only, cold-chain-management only etc.). The demands upon providing the possibility to allow for different views and for a number of varying analysis methods are high. This has the consequence that not only on the data layer, but also on the service layer, careful consideration has to be given to the reusability of data in different contexts. To achieve this, querying mechanisms have to be generic and flexible. It does not suffice to provide tracking and tracing only to achieve transparency in the food sector. A number of other attributes are of increasing interest, not only to allow for quality control but also to also be able to market quality products. To accommodate this demand, it is important that the data models used are designed to allow for extensibility without breaking backwards compatibility from the ground up. It is a crucial factor for success to find a set of standards and methods that are up to the task but at the same time simple, clear and generic enough to be accepted by system providers with their diverse development and computing environments and toolsets. Ideally, a set of orthogonal specifications without unnecessary duplication of functionalities is chosen. The task of building a backbone can be facilitated to a great extent by reuse of existing standards and leveraging the capabilities and networks of existing organisations.

For each of the four building blocks identified (protocol, syntax, semantics, identification) for creating a backbone solution, several technologies exist to provide the necessary functionality.

Complex messaging protocols based on SOAP can be used in well-defined, controlled environments but will probably be too difficult to implement on a larger scale. RESTful web services have been proven to be better suited to networks with large numbers of small, anonymous stakeholders and a lack of control.

On the syntax level, XML is already widely used in the food and agricultural sector. It is thus well understood and can easily be implemented by most stakeholders. The disadvantage of XML is its inefficiency during data transfer on-the-wire due to its verbosity. This may result in problems on large scale tracking and tracing. There are however replacements for XML that are easy to handle and can be converted without much effort like e. g. JSON, so that syntax issues will not be a limiting factor in implementing the backbone.
Data items in the basic tracking and tracing data set described above are semantically (relatively) well defined. The depicted backpack of additional data however is a very flexible and extensible container that calls for concise formalized and machine readable semantics of its content. A number of data dictionaries, thesauri and encoding systems exist in the food and agricultural sector that can be used for that purpose. Most of them however can not interoperate with other vocabularies at the moment or contain too few relationships between concepts and terms (i. e. are flat thesauri) to be useful for flexible and dynamic information exchange using e.g reasoning mechanisms to derive missing data. Thus increasing the usefulness of a European backbone solution by offering more than just simple tracking and tracing will reach its limits quickly if this problem is not tackled. The Food and Agricultural Organization of the United Nations (FAO) currently provides the KOS registry for collecting and referencing different knowledge organisation and sharing systems in the agricultural and food sector thus providing a basis from which further harmonization and interconnection work could start.

Generating unique identifiers for objects is crucial in an open, global network. It usually requires hierarchical distribution of control over certain subsets of the value space. For identification in services, using URIs can be considered best practice. There are standard mechanisms for creating them and numbers can easily be turned into URIs by attaching a special prefix denoting the kind of identifier. Several organisations exist that can deal with maintenance of the upper levels of the hierarchy. The international domain name system registrars or GS1 offering company codes are examples. By careful consideration of the URI structure, compatibility with other numbering system can be achieved, even if not following their respective standard procedure of registration. As such, it would be possible to setup special identifier value spaces for use by small and medium sized enterprises that are not willing or not able to pay for taking part in more expensive identification systems.

The blueprint proposal for a tracking and tracing solution in the agricultural and food sector described here, recommends the use of standards and methods that are simple, clear and well established. The focus is on free and open solutions to avoid any licence issues and to facilitate a wide acceptance. The technologies proposed are platform independent to allow all stakeholders to integrate existing systems wherever necessary.

However, in several areas further research and development is needed. The available controlled vocabularies still need to be extended, especially regarding the integration of intermediate and agricultural products. Further development towards the establishment of ontologies in this area is highly desirable. The syntax used for data transmission needs a final definition. This process should start with the core data and proceed with the backpack data, where the stakeholders of each production chain need to be involved. Finally, the integration of existing standards must be worked out in more detail. This work needs to be done in close cooperation with the standardisation organisations which are active in this sector.
### VI POLICY STATEMENTS AND LEGAL REQUIREMENTS

**Prepared by:**

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[43] Earlier version published as deliverable within the EU project Transparent_Food: D5.3 Report of analysis public policy statements and legal requirements and expectations of food transparency schemes and their role in achieving policy and regulatory goals
ABSTRACT

The focus of this chapter is an assessment of the use of food labelling and logos as a policy instrument within European Union (EU) legislation and regulation and its wider policy objectives. Food transparency schemes are identified through the use of labels and logos and/or traceability requirements.

Most notable within the chapter is the use of labels to further policy and regulatory goals. Such goals cover wide ranging areas but include; the clear provision of information to consumers to enable trust and confidence and consumer choice, support for producers and strengthening of EU market(s); increasing environmental sustainability of food production.

In this chapter, analysis of regulatory and policy goals are categorized under three separate sections in line with the Transparent_Food project structure. These are 1) Food Safety 2) Food Quality and 3) Food (chain) Integrity. Most notable is the broadening of Food Quality to represent more than the composition and characteristics of food. Instead, as the chapter reveals, the understanding of Food Quality is widening to include farming attributes including process and production methods and environmental impacts. Public health policy goals such as reducing the rates of obesity and so diet related diseases are also being addressed by labelling criteria for foods.

The chapter finds that labelling and logos based on certification schemes are seen as potential policy instruments to advance a range of policy goals: from signalling a common base-line standard as with the EU Organic logo, to rewarding farmers for their wider role in maintaining public goods such as natural landscapes, to ameliorating the carbon and other adverse impacts of food chains and food products. The aspiration to further food based labelling schemes is still restricted by lack of clear and accepted methodologies to provide a basis for clear measurement of the impact of a food process or of the final product. This is the case with animal welfare and carbon impacts at present. Private schemes are ahead of legislation on signalling environmental and social and ethical impacts of food, and in some areas, such as Fair Trade, the European Commission considers the innovation and dynamism of private market based schemes to be the more effective approach at present.

Nonetheless, food transparency schemes are considered to have a real or potential role in both the meeting of and the communication of policy goals. Thus, the complexity of the ever broadening food policy landscape is reflected in the policy and regulatory decisions making bodies of the EU and their reliance on the use of logos and labels.
1 Introduction

The chapter draws on EU legislation and policy documents to analyse the extent to which labels and logos are used as instruments of public policy. This chapter responds to the following questions:

- Where is labelling an important instrument of public policy?
- To what extent are labels and logos relied upon to produce policy and regulatory goals?

Public policy statements and the specific EU regulations and directives are used to establish the expectations of labelling and certification and their role in achieving policy and regulatory goals. In this chapter, analysis of public policy statements and regulatory requirements are set out under separate sections in accordance with the Transparent_Food project structure of: 1. Food Safety 2. Food Quality and 3. Food (Chain) Integrity. However, one finding of this chapter is that Food Quality is increasingly being deployed by policy makers to cover a wide range of areas that go beyond the notion of Food Quality as essentially concerned with safety and product composition. Food Quality clearly overlaps with overlaps with the areas currently designated in the chapter under Food Integrity. This chapter divides these categories and sub categories as follows:

I. Food Safety and II. Food Quality
- Food Safety and Food Quality (composition)
- Food Quality (Nutrition and Health)
- Food Quality (agricultural produce)

III. Food Chain Integrity
- Origin (referring to place, region and country)
- Environment
  - Production Process Method
  - Environment –Impact/standards
- Ethical and Social
  - Animal Welfare
  - Labour and working conditions
  - Terms of trade
  - Social and Community Capital
  - Cultural and Social

1.1 Definition of logos and labels

Information for consumers can be communicated in a range of ways. Information can be offered and shared with consumers at both the point of sale and, in the space-of-sale – for example, in-store. In addition, information can be communicated virtually, via websites. Labelling is a method of communicating information to consumers via the product itself. Different ‘fields of vision’ exist on labels, for example, front of pack. A regulatory definition of labelling is contained within Article 1 (paragraph 3 a) of Directive 2000/13/EC which defines labelling as:
‘any words, particulars, trade marks, brand name, pictorial matter or symbol relating to a foodstuff and placed on any packaging, document, notice, label, ring or collar accompanying or referring to such foodstuff’.

In this chapter, logos are considered within the scope of the definition of labelling as they can cover one or more of “trademarks, brand name, pictorial matter or symbol...” Logos represent an attempt to signal information in an abbreviated format the certification of certain designated characteristics of the history and/or composition of the product in question.

1.2 Distinction between mandatory and voluntary
A distinction between mandatory and voluntary labelling is required. Mandatory labelling reflects the requirement to compulsorily include information on the label (e.g. allergens - see 2.3). The term voluntary can have two meanings in the context of labelling. Labelling may be voluntary but the standards and governance associated with a particular area are mandatory. One example is Genetically Modified Organism (GMO) which is a voluntary label but foodstuffs labelled with GMO-free must meet particular standards enacted in EU legislation (see 7.1.2). Voluntary labelling however may also refer to information which meets standards devised by private or national schemes (e.g. fair trade schemes).

1.2.1 Labelling regulation: Directive 2000/13/EC
All labelling, mandatory or voluntary, and associated standards are governed by Article 2 Directive 2000/13/EC which sets out what labelling must do. Paragraph 1 of Article 2 of the Directive 2000/13/EC states the following:

1. The labelling and methods used must not:
   (a) be such as could mislead the purchaser to a material degree, particularly:
      (i) as to the characteristics of the foodstuff and, in particular, as to its nature, identity, properties, composition, quantity, durability, origin or provenance, method of manufacture or production;
      (ii) by attributing to the foodstuff effects or properties which it does not possess;
      (iii) by suggesting that the foodstuff possesses special characteristics when in fact all similar foodstuffs possess such characteristics;

1.2.2 Marketing standards
Marketing standards are a further legislative tool which governs information placed on food label. While not an explicit focus of this chapter, marketing standards have a role to play in contributing to meeting policy aims. For example, one aim of marketing standards is to indicate to consumers the
quality (product and composition) of a product and to prevent the misleading of consumers on both the composition and farming attributes of a product.

1.3 DG Sanco perspective on labelling
The chapter ‘Labelling: competitiveness, consumer information, better regulation’ asked key questions on the scope and nature of EU regulation and labelling. In supporting labelling more generally, the European Commission’s Directorate General for Health and Consumers - DG Sanco (2006), set out the aims of their strategic approach to labelling:

- ‘provide consumers with necessary information to enable them to make safe, healthy and sustainable choices
- create a pro-competitive market environment in which dynamic, efficient, innovative operators can make full sense of the power of labelling to sell their products
- be consistent, coherent and transparent
- create common framework and rules in order to eliminate barriers to free circulation of goods’

1.4 EU Commission: informing consumers about agricultural product quality
More recently, in 2009, the EU Commission’s communication on agricultural product quality policy emphasised the need to inform customers about the qualities of the products available. Information, it was held, is required in order to enable consumers to respond and pay a fair price. Sustaining both competitiveness and profitability, according to the communication partly relies on consumers knowing about the qualities of products. The EU Communication defines the qualities of agricultural products as follows:

‘Agricultural product ‘qualities’ includes both ‘product characteristics’ (physical, chemical, microbiological and organoleptic features – size, appearance, taste, look, ingredients, etc.) and farming attributes (production method, type of animal husbandry, use of processing techniques, place of farming and of production, etc).

(EU Communication: Agricultural product quality policy 2009).

1.5 Information sources for this chapter
Policy and legislation in the areas of labelling and certification are rapidly evolving. Consequently, some sections in this chapter draw on proposals for regulation rather than regulations and directives that have been adopted (e.g. Section 3.2.1 on nutrition content). In addition, the EU has discussed

44 ‘Labelling: competitiveness, consumer information, better regulation for the EU’


COM(2009) 234 final

299
the possibility of introducing new schemes with a particular policy focus. One example is the development of a high-nature value farming scheme which is suggested to provide benefits for farmers and the environment (see 7.2.2).

2 Food safety and food quality (composition)

Food Safety and the quality of food in terms of its composition as its moves along the chain is a prime concern of EU regulation.

2.1 Mandatory information: Directive 2000/13/EC sets out the general labelling requirements including the compulsory information which must be listed on food products. These are:

- Name of product
- List of ingredients
- Use-by-date
- Special conditions of use
- Additional rules exist for specific food groups and types (meat, diabetic)
- Compulsory identification (name and address)

Article 9 of the proposal for a regulation on the provision of food information to consumers lists the following particulars as mandatory:

- the name of the food;
- the list of ingredients;46
- any ingredient listed in Annex II causing allergies or intolerances, and any substance derived there from;
- the net quantity of the food;
- the date of minimum durability or the ‘use by’ date;
- any special storage conditions or conditions of use;
- the country of origin or place of provenance
- instructions for use when it would be impossible to make appropriate use of the food in the absence of such instructions;
- with respect to beverages containing more than 1,2% by volume of alcohol, the actual alcoholic strength by volume;

46 Exceptions exist in which a list of ingredients is not required. Article 20 of the proposal for a regulation on the provision of food information lists the following as not requiring a list of ingredients:
- Fresh fruit and vegetables, including potatoes, which have not been peeled, cut or similarly treated
- Carbonated water
- Fermentation vinegars derived from a single basic product
- Cheese, butter, fermented milk and cream, to which no ingredient has been added other than lactic products, enzymes and micro-organism cultures essential to manufacture, or in the case of cheese other than fresh cheese and processed cheese the salt needed for its manufacture.
- Wine
- Foods consisting of a single ingredient where the name of the food is identical with the ingredient name or the name of the food enables the nature of the ingredient to be clearly identified.
• a nutrition declaration.

In addition Annex III of the proposal for a regulation on the provision of food information states additional specific types or categories of food that are required to be included in labelling. These are:

• Foods packaged in certain gases and foods whose durability has been extended as a result (for example, milk which, because of treatment is able to last longer seven days may not be labelled as ‘fresh’).
• Food containing sweeteners
• Foods containing liquorice

2.2 Food additives, food sweeteners and food colouring

Labelling regulation for food additives is set out in Regulation EC 1333/2008 on food additives. Within the regulation, a distinction is made between the labelling requirements of food additives not intended for the sale to the final consumer and the labelling of food additives intended for sale to the final consumer.

Article 21 and 22 set out the requirement for the labelling of food additives not intended for sale to the final consumer. Article 21 states that labelling must be easily visible, clearly legible and indelible. Further, the information presented is required to be in language easily understandable to purchasers. Article 22 sets out the specific pieces of information required on packaging or containers of food additives (which are not intended for sale to the final consumer)47.

Article 23 lays down the requirements of labelling of food additives intended for sale to the final consumer. Paragraph 1 states that food additives ‘sold singly or mixed with each other and/or other food ingredients intended for sale to the final consumer may be marketed only if their packaging contains the following information:

• the name of the E-number of each food additive or a sales description which includes the name and E-number of each food additive;

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47 Paragraph 1 of Article 22 states the following shall be included on labelling of food additives not intended for sale to final consumer.
(a) the name and/or E-number laid down in this Regulation in respect of each food additive or a sales description which includes the name and/or E-number of each food additive.
(b) the statement ‘for food’ or the statement ‘restricted use in food’ or a more specific reference to its intended use.
(c) if necessary, the special conditions of storage and/or use
(d) a mark identifying the batch or lot
(e) instructions for use, if the omission thereof would preclude appropriate use of the food additive
(f) the name or business name and address of the manufacturer, packager or seller;
(g) an indication of the maximum quantity of each component or group of components subject to quantitative limitation in food and/or appropriate information in clear and easily understandable terms enabling the purchaser to comply with this Regulation or other relevant Community law; where the same limit on quantity applies to a group of components used singly or in combination, the combined percentage may be given as a single figure; the limit on quantity shall be expressed either numerically or by the quantum satis principle;
(h) the net quantity
(i) the date of minimum durability or use-by-date
(j) where relevant, information on a food additive or other substances referred to in this Article and listed in Annex IIIa to Directive 2000/13/EC as regards the indication of the ingredients present in foodstuffs

301
The statement ‘for food’ or the statement ‘restricted use in food’ or a more specific reference to its intended food use

*Regulation EC 1333/2008* contains specific clauses for the labelling of tabletop sweeteners and requires manufacturers to include the term ‘...-based table-top sweetener’, using the name(s) of the sweetener(s) used in its composition in the sales description of table-top sweeteners. In addition, table-top sweetener(s) containing polyols and/or aspartame and/or aspartame-acesulfame salt are required to be labelled with the following warnings:

- polyols: ‘excessive consumption may induce laxative effects’;
- aspartame/aspartame-acesulfame salt: ‘contains a source of phenylalanine’.

*Article 24 of Regulation EC 1333/2008* sets out the labelling requirements for foods containing certain food colours. Food containing one or more of the food colours stated in the regulation must be labelled on the food and accompanied by the following statement ‘may have an adverse effect on activity and attention in children’.

2.3 Allergens: *Directive 2007/68/EC* details the list of 14 ingredients which are identified as allergenic. Clear labelling indicating that products contain these products is required under the Directives. The following foods require clear labelling with an indication of their potential allergenic effect:

- Celery
- Cereals containing gluten (wheat, barley, rye and oats)
- Crustaceans (lobster and crab)
- Eggs
- Fish
- Lupin
- Milk
- Molluscs (mussels and oysters)
- Mustard
- Nuts
- Peanuts
- Sesame seeds
- Soybeans
- Sulphur dioxide and sulphites (above 10 mg per kg or litre).

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*Annex V of Regulation EC 1333/2008* lists the following colours as subject to the regulation requirements:
- Sunset yellow (E 110)
- Quinoline yellow (E 104)
- Carmoisine (E 122)
- Allura Red (E 129)
- Tartrazine (E 102)
- Ponceau 4R (E 124)
Article 22 and Annex II of the proposal for a regulation on the provision of food information repeats the provision for the labelling of ingredients which may cause allergy or intolerance in Directive 2007/68/EC.

2.4 Regulation (EC) 178/2002 lays down general principles and requirements of food law and food safety procedures, and established the European Food Safety Authority (EFSA). The scope of application covers all stages of production, processing and distribution of food and feed. EFSA provides scientific advice, information and data on risks associated with the food chain. The presence of EFSA supports the framework of food safety set out by Regulation (EC) 178/2002 and its communication with consumers aims to increase confidence in EU food and food markets.

Policies goals which serve to ensure food safety rely on a strategy of risk management and the concept of traceability. Traceability is detailed in Article 18 of Regulation (EC) 178/2002. Traceability of foodstuffs is relevant for the consumer as well as producers and business-users of foodstuffs. Traceability enables risk management along supply chains and was developed, in the context of food safety, as a response to food crises in the EU in the early 1990s (Arienzo et al 2008). Traceability is understood here as a precondition for food chain transparency. Traceability affords transparency to primarily operate between businesses to business.

Several pieces of legislation make requirements for traceability systems – some of which go beyond food safety and recall needs (e.g. see GMO in section 7.1.2; fishery and aquaculture products in section 7.1.4; geographical indicators in section 6.1).

2.5 Legislation has created mandatory traceability, for example, an obligatory labelling and registration scheme for beef exists in the EU. Regulation (EC) No 1760/2000 established a system for the identification and registration of bovine animals and the labelling of beef and beef products. The legislation created a traceability system between a carcass quarter or pieces of meat to an individual animal or a group of animals. Beef and veal sold in the EU must be labelled with information on the following:

- country of origin
- country of slaughter
- slaughter company
- country(-ies) of further processing, company(ies) of further processing.

Regulation (EC) No 1760/2000 requires each Member State to establish an identification and registration system for bovine animals. This system operates with the use of:

- ear tags for the individual animal,
- information in databases,
- animal passports,
- individual registers kept on each holding (farm records).

In addition Regulation (EC) No 1760/2000 sets outs specific labelling requirements for minced beef meat. Minced beef must show:

- the reference number or code establishing the connection between the meat and the animal (or group of animals) from which the meat was derived;
- the indication “Produced in” (with the name of the country of production) and the indication of “Origin” where the country or countries concerned are not the same as the country of production;
- the country of slaughter;

2.6 Individual traceability of ovine and caprine animals was established in Council Regulation (EC) 21/2004. The regulation states that experience, in particular, with the outbreak of foot-and-mouth disease created the necessity to set down a rigorous system of traceability which relies on the identification and registration of ovine and caprine animals and allows for continuous tracking of animals. Electronic tagging is the means of identification used to identify each animal set down in Annex of Council Regulation (EC) 21/2004. Tagging of animals is supported by a broader system of traceability. Specifically, Paragraph 1, Article 3 of Council Regulation (EC) 21/2004 states that each Member State shall implement a system which allows for the identification and registration of animals based on the following elements:

a) means of identification to identify each animal
b) up-to-date registers kept on each holding;
c) movement documents
d) a central register or a computer database.

2.7 Summary
Food safety is a key policy and regulatory goal of the EU. Consequently the use of food transparency schemes to fulfil food safety policy and regulatory goals are characterised by:

- legislation which makes the mandatory provision of information on labels (as listed in section 2.1 and 2.2.). For example, as discussed in section 2.3 the use of labels to signal potential food allergens to consumers as a result of mandatory labelling legislation contributes to safe food consumption.
- the role of traceability in providing information along the food supply chain. This primarily operates between business to business. Traceability is enacted in key EU legislation and has subsequently developed in application to specific food regulations (e.g. labelling of beef and beef products as described in section 2.5)
3 Food Quality (health and nutrition)

Food quality, in this chapter, possesses two meanings linked to the composition of food. In the previous discussion, the approach to food quality was informed by food safety, for example, potential allergen content of food. In this section, the food quality emphasis is derived from a focus on the health and nutrition aspects of food composition.

3.1 Health claims

EC Regulation No 1924/2006 is the regulation for which accordance of all approved health claims is required. The legislation aims to avoid the creation of barriers to the free movement of foods in the internal market as a result of different national provisions. A further aim of the legislation was to ensure a high level of protection for consumers in relation to foods which bear nutrition and health claims. General claims about benefits to overall good health, such as 'healthy' are only allowed if they are an appropriate and approved claim. Nutrition and health claims are required to be based on accepted scientific evidence. EFSA is the institutional body which oversees and regulates health claims. The annex of Regulation (EC) 1924/2006 sets out specific terms which are in the scope of the legislation. These are include49:

- Low fat
- Fat-free
- Low-saturated fat
- With no added sugars
- Low sodium/salt
- Source of fibre
- Source of protein
- Source of [name of vitamins and/or [name of minerals]

49 The full list of nutrition claims are as follows: low energy; energy-reduced; energy-free; low fat; fat-free; low-saturated fat; saturated fat; low sugars; sugars-free; with no added sugars; low sodium/salt; very low sodium/salt; sodium-free or salt-free; source of fibre; high fibre; source of protein; high protein; source of [name of vitamins and/or [name of minerals]; high [name of vitamin/s and/or [name of mineral/s]; contains [name of the nutrient or other substance]; increased [name of the nutrient]; reduced [name of the nutrient]; light/lite; naturally/natural.

Examples of the rules for specific claims:

- Low fat: A claim that a food is low in fat, and any claim likely to have the same meaning for the consumer, may only be made where the product contains no more than 3 g of fat per 100 g for solids or 1.5 g of fat per 100 ml for liquids (1.8 g of fat per 100 ml for semi-skimmed milk.
- Fat-free: A claim that a food is fat-free, and any claim likely to have the same meaning for the consumer, may only be made where the product contains no more than 0.5 g of fat per 100 g or 100 ml. However, claims expressed as ‘X % of fat free shall be prohibited.
- Low-saturated fat: A claim that a food is low in saturated fat, and any claim likely to have the same meaning for the consumer, may only be made if the sum of saturated fatty acids and trans-fatty acids in the product does not exceed 1.5 g per 100 g for solids or 0.75 g/100 ml for liquids and in either case the sum of saturated fatty acids and trans-fatty acids must not provide more than 10 % of energy.
- Contains [name of the nutrient or other substance]
- Increased [name of the nutrient]
- Reduced [name of the nutrient]
- Light/lite
- Naturally/natural

3.2 Nutrition content: Council Directive 90/496/EEC on Nutrition Labelling of Foodstuffs regulates the nutrition labelling on foods. The Annex to the Nutrition Labelling Directive (90/496/EEC) lists vitamins and minerals which may be declared on the nutrition label, their recommended daily allowances (RDAs), and specifies what is a ‘significant amount’ (15% of the RDA per 100g or 100ml)\textsuperscript{50}.

3.2.1. In June 2010, MEPs supported the European Commission proposal for a regulation on the provision of food information that nutrition labelling should be mandatory and include the following:
- Energy value;
- The amounts of fat, saturates, carbohydrates with specific reference to sugars, and salt.

Article 29 (2) of the proposal states that the nutrition declaration may include the amounts of one or more of the following:
- trans fats;
- mono-unsaturates;
- polyunsaturates;
- polyols;
- starch;
- fibre;
- protein;
- minerals and vitamins listed in Annex XI of the proposal

Specifically the proposal states that quantities of fat, saturates, sugar and salt - as well as energy - must be indicated on the front of food packs. These should be accompanied by guideline daily amounts and expressed with per 100g or per 100ml values. MEPs also voted for details of protein, fibres and transfats to be included elsewhere on the packaging. The adoption of these rules will make the provision of nutrition information on foodstuffs mandatory.

Some exemptions of the regulation proposal exist\textsuperscript{51}. The proposal, when in force, will merge and amend existing legislation in this area (e.g. Directive 90/496/EEC and Directive 2000/13/EC)

\textsuperscript{50} The Directive does not apply to natural mineral waters or other waters intended for human consumption, or food supplements (Article 28 paragraph (1)(2)).
\textsuperscript{51} For example, the article 29 of the proposal suggests that the regulation does not apply to wine, beer or spirits.
3.2.2 As explained by the Commission, the proposal to regulate nutrition labelling was informed by the following policy considerations and objectives:52

- Support health conscious food choices and contribute to the reduction of obesity and non-communicable diseases (e.g. diabetes)
- To allow key nutrition information to be more easily accessible, understandable and more widely applied to and for the consumer
- Ensure a consistent and harmonised approach at an EU level thus allowing a unified approach to labelling by stakeholders
- To create a level playing field for companies to compete53

The EU platform on Diet, Physical Health and Activity identifies consumer information including labelling as a key part of its strategy of action54. This was emphasised in the White Paper on a Strategy for Europe on Nutrition, Overweight and Obesity-related Health Issues. The White paper highlighted the need for consumers to have access to clear, consistent and evidence-based information. Recognition is made of the role of the private sector in developing clear information systems and improved labelling to enable consumers to be best-placed to make an informed choice55. The paper stresses that the EU should take a leading role in creating a common approach on this issue56. Recommended in the paper is the need for mandatory nutrition labelling to help consumers make a healthy choice of food57. The White Paper is cited in the preamble of the proposal for regulation.

3.2.3 While agreement was made between MEPS to support the regulation of nutrition information on food products, divergence and debate exists among stakeholders regarding how precisely such information should be communicated to consumers. Following discussion in the EU parliament, MEPS voted in the proposal for nutrition labelling to be displayed in panel style with RDAs rather than the traffic light style.

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52 Specifically, the amendments proposed by the Commission states:

The free movement of safe food is an essential aspect of the internal market and contributes significantly to the health and well-being of citizens and to their economic interests. This regulation will both serve the interests of the internal market, by simplifying the law, ensuring legal certainty and reducing red tape, and benefit citizens by requiring clear, comprehensible and legible labelling of foods. (Amendment 1 Proposal for a regulation Recital 2)

53 Some exceptions were suggested, for example, food that is not prepacked, such as meat purchased from a butcher and handcrafted food products from microenterprises (for example, handcrafted food at fundraising events, such as school and church fetes).

54 A European Platform For Action - Diet, Physical Activity And Health 15 March 2005 p2

55 Point 17 of White Paper on a Strategy for Europe on Nutrition, Overweight and Obesity-related Health Issues

56 Point 18 White Paper on a Strategy for Europe on Nutrition, Overweight and Obesity-related Health Issues

57 Point 31 White Paper on a Strategy for Europe on Nutrition, Overweight and Obesity-related Health Issues
Article 31 of the proposal for a regulation on the provision of food information states that nutrition information shall be expressed using the measurements units of Recommended Daily Allowance (RDAs). Example of this format is provided in Annex XIII of the proposal. Energy and nutrients are to be expressed per 100g or 100ml or per portion. Article 32 details the standards of which per portion measurements must meet. For example, portions must be quantified (i.e. statement of how many portions contained in pack is required on the label)

3.3. Summary
Food quality in relation to health and nutrition and labelling is an emerging area of policy and regulation. Policy and legislative expectations in this area are numerous and include:

- Avoid the misleading of consumers (as discussed in section 3.1, regulation on health claims aims seek to avoid the misleading of consumers)
- Create fairer market for supply chain actors including manufacturers and producers
- Provide legible, clearer and consistent information to consumer
- Balance interests of consumers, interest groups and industry
- Contribute to the health policy drives, in particular on obesity.

4 Food Quality (marketing standards)
Marketing standards are a key instrument of agricultural product quality policy. Marketing standards enacted in legislation govern the use of terms and information used on labels to describe food (product and process). An additional and complementary aim of marketing standards is the prevention of misleading consumers on both the composition of products and farming attributes of a product. Moreover, this was recently emphasised in a communication from the European Commission on the topic of agricultural product quality policy. While the complexity of detail contained within marketing standards was noted as a potential constraint for farmers and producers, emphasis was also placed on the significant role of marketing standards in informing consumers about characteristics and farming attributes of food products.

Through their labelling requirements, marketing standards are used to inform consumers about the following:

- differentiation between specific product types, for example, whether a fruit juice is derived from concentrate or made from pure fruit juice
- the quality and compositional integrity of a product. Marketing standards stipulate the composition requirements of a product for example chocolate (cocoa and vegetable fat content) and spreadable fats (butter, margarine and blends). Thus consumers are provided with a guarantee regarding the quality of the product

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• the classification of a product, for example, size, weight and freshness. Examples of products subject to marketing standards in this area are fish, fruit and vegetables, and eggs. A key aim of the marketing standards focusing on classification of products in these areas is to enable consumers to have a sound basis on which to compare products. Moreover, in classifying quality (on the basis on freshness for eggs, fresh fruits and vegetables) the marketing standards aimed to indicate to consumers about the perishable nature of particular products
• products which claim to be produced from a particular production process method or place of origin. For example, the distinction and appropriateness of using terms such as ‘organic’ and ‘free range’.

Taken together, the labelling requirements of marketing standards serve to indicate a standard of product and thus indicate quality to consumers. Marketing standards can be used as a form of market differentiation through their reserve terms, for example, ‘free range’. A significant number of products are subject to market standards enacted in EU legislation, in particular, Council Regulation (EC) No 1234/2007 establishing a common organisation of agricultural markets and on specific provisions for certain agricultural products (Single CMO Regulation).

5 Food Quality (agricultural produce)

The European Commission has begun to emphasise the links between good farming practices and the quality of food produced from these practices. The Commission’s Green Paper on Agricultural Product Quality recognised that the meaning and form of food quality goes beyond product standards relating to food safety. In particular, quality is linked to meeting consumer expectations. The Green paper noted that ‘the demands of the market are diverse’ and, as a consequence, ‘consumers increasingly pay attention to the contribution made by farming on sustainability, climate change, food security and development, biodiversity, animal welfare, and water scarcity’.

The quality challenge is defined in terms of how to turn the burden of expectations and demands of consumers into premium marketplace returns for farmers. In order to achieve this, the Green Paper highlighted the importance of distinguishing those products that meet consumers’ expectations, for example, by revealing the production process method or place of farming. However, it was recognised that there has been a relative lack of success in communicating to consumers about the quality of EU farming standards. Hence, the focus within the Green Paper is on exploring ways in which the EU’s schemes and regulations can support farmers in their efforts of highlighting the quality of the foods produced.

Following the Green Paper, the EU Commission laid down a strategic approach to agricultural product quality in a Communication put forward on May 29 2009. The strategic approach emphasises that the role of agricultural quality produce policy is ‘inform buyers and consumers about product

characteristics and farming attributes\textsuperscript{60}. In addition, the development of agricultural product quality aims to contribute to meeting of the objectives of CAP\textsuperscript{61}. The main quality measures highlighted in the Commission Communication were:

- EU farming requirements
- Marketing standards
- Geographical indications
- Organic farming

Thus, Food Quality is conceptualised as a range of attributes rather than one. It can refer to food safety and composition as well as the potential impact of consumption (for example, health claims and nutrition). The Green Paper consultation and the subsequent EU Communication on agricultural product quality illustrates how the concept of quality is broadening and is increasingly operating in multiple ways – for example, in relation to meeting farming requirements and the place of production.

While farming standards and marketing standards are referred to as key quality measures, this chapter focuses on those quality measures captured with labels and logos as part of food transparency schemes, consequently less detail is presented here regarding the marketing standards. The next three sections of this chapter explore in greater detail the EU’s approach to the use of labels and logos in highlighting food quality relating to food produce.

6 Origin (referring to place, region and country)

Information on origin refers to place, region and country and includes methods of production that are specific to those places and regions in different ways. The specificity of such geographically located production is the basis for the legal status of schemes known collectively as Geographical Indicators (GIs).

6.1 Protected Designation of Origin (PDOs), Protected Geographical Indicator (PGIs) and Traditional Speciality Guaranteed (TSGs).

The PDO label relates to a food product originating in a specific region where the quality of that product is due \textit{exclusively} to a particular geographical environment with its inherent human and natural factors. The PGI label reflects a product originating in a particular region, which possesses a specific quality, reputation, or other characteristics \textit{attributable} to that geographical origin (but not necessarily due to its natural environment). Hence, in the cases of PDOs and PGIs there are specific

\textsuperscript{60} Communication: on agricultural product quality policy (2009) Brussels, 28.5.2009

attributes to the production process that are attributable to differing degrees to the geographical area of production. Eligibility for PGI certification requires that at least one of the stages of production, processing or preparation is required to take place in the area in order for certification to be awarded. The regulation for schemes exists under Regulation (EC) 510/2006 on the protection of geographical indications and designations of origin for agricultural product stuffs.

Traditional Speciality Guaranteed (TSGs) is a scheme in which the traditional character, either in the composition or means of production of a food is indicated to the consumer. It aims to identify and protect names of traditional and speciality products. The TSG scheme is enacted by Regulation EC 509/2006. In 2009, the communication on agricultural product quality discussed the possibility of abolishing the scheme because of the lack of up-take and response.

6.1.1 The policy aim behind the PDO and PGI instruments is to ensure integrity of foodstuffs and protect the reputation of regional foods. The schemes are similar to appellation systems that exist in France and Italy. Integrity of foods is protected as the certification label indicates the authenticity of the product. It prevents attempts to reproduce foodstuffs outside of a particular region or in using a different method and thus prevents the misleading of consumers and specialised producers. The main aims of the PDO and PGI schemes are:

- to ensure consumers receive clarity on information relating to origin (and authenticity) of product
- to promote and include small production areas and enable economic benefits (especially in rural areas) increase income of certificate holders
- to contribute to local and regional economies and thus contribute to the prevention of population decline in rural areas.

The PDOs and PGIs are currently under review with consideration being made of merging PDO and PGI and incorporating sustainability based criteria.

6.1.2 Impact assessment of PDO schemes

An assessment of the value added by quality assurance schemes revealed that, in a case study of Iberian Ham (of which some is PDO certified as “Dehesa de Extremadure”) producers gained some competitive advantage from the scheme. The main benefit for producers is the opening of market niches and differentiation. The PDO was also considered to fulfil some aspects of CAP objectives, for example, with those linked to the environment. In the case of the PDO certified Iberian ham, the scheme’s provisions supported the extensive production system and “dehesa” woodlands upon

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which production partly relied. The creation of support of the woodlands by the PDO in turn contributed to development and preservation of local identity and tradition and biodiversity. Developing the commercial strategy to increase consumer awareness was one key recommendation of the impact assessment. This together with an approach that prevents market saturation of PDO (Iberian ham) will enhance the benefits of PDO certification.

6.2 Non-scheme based country of origin labelling

Article 13(8) of Directive 2000/13/EC states that the labelling of foodstuff shall be compulsory when the ‘particulars of the place of origin or provenance where failure to give such particulars might mislead the consumer to a material degree as to the true origin or provenance of the foodstuff;’

The mix of the voluntary and mandatory approach is explained in DG SANCO’s consultative document regarding revision of the labelling regulation. Paragraph 29 states that origin in Directive 2000/13/EC is ‘not normally considered as necessary information to enable consumers to make an informed choice, because that origin is not an important element to characterise or to identify the product.’ In addition, consumers are able to access some information on the origin of foodstuffs because of the mandatory identification of ‘the manufacturer or packager, or of a seller established within the Community’.

In June 2010, the topic of origin labelling arose as MEPs debated the regulatory proposal on the provision of food information to consumers. The proposal passed the first reading stage with several text amendments. The original proposal retained the approach set out in earlier EU regulation Article 13(8) of Directive 2000/13/EC which seeks to prevent the misleading of consumers on the topic of origin. Subsequent amendments have been proposed which if passed would usher in

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65 ‘Labelling: competitiveness, consumer information, better regulation for the EU’


Paragraph 29, p8

66 European Parliament legislative resolution of 16 June 2010 on the proposal for a regulation of the European Parliament and of the Council on the provision of food information to consumers


‘the country of origin or place of provenance where failure to indicate this might mislead the consumer to a material degree as to the true country of origin or place of provenance of the food, in particular if the information accompanying the food or the label as a whole would otherwise imply that the food has a different country of origin or place of provenance; in such cases the indication shall be in accordance with the rules laid down in Article 35(3) and (4) and those established with Article 35(5).
significant change regarding the scope of application of origin labelling. In particular, the new amendments of the proposal of regulation on the provision of food information states that the country or place of provenance shall be given for the following:

- meat;
- poultry;
- dairy products;
- fresh fruit and vegetables;
- other single-ingredient products; and
- meat, poultry and fish when used as an ingredient in processed foods.  

Additional labelling requirements are proposed for particular types of food, for example meat and poultry. In this case, the following was stated:

For meat and poultry, the country or place of provenance may be given as a single place for animals only where the animals have been born, reared and slaughtered in the same country or place. In other cases information on each of the different places of birth, rearing and slaughter shall be given.  

MEPs supported extending this to all meat, poultry, dairy products and other single-ingredient products. They also voted for the country of origin to be stated for meat, poultry and fish when used as an ingredient in processed food. However, this may be subject to an impact assessment. Meat labels in this instance will indicate where the animal was born, reared and slaughtered.

6.3 Summary
The policy aims behind the Geographical Indicators and Country of Origin Labelling (COOL) include:

- Specific attributes to a food product deriving form its geographical place of production
- Enhance economic wellbeing and productivity of producers because origin is used a unique selling point (PDO, PGI & COOL)
- Consumers associate origin with quality and safety thus this has created a push towards origin labelling
- Prevent the misleading of consumers.

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68 Amendments 101 and 328 Proposal for a regulation Article 9 – paragraph 1(i)

European Parliament legislative resolution of 16 June 2010 on the proposal for a regulation of the European Parliament and of the Council on the provision of food information to consumers

69 Amendments 101 and 328 Proposal for a regulation Article 9 – paragraph 1 (i)

European Parliament legislative resolution of 16 June 2010 on the proposal for a regulation of the European Parliament and of the Council on the provision of food information to consumers

7 Environment
This section focuses on two aspects of the domain of environment: firstly, process and production method(s) and subsequently environmental impacts of production.

7.1 Process and Production Method

7.1.1 Organic

In 1991 EU introduced farming regulation for ‘organic’, ‘biological’ ‘ecological’, and ‘eco’ and ‘bio’ labels. Organic is defined in the EU legislation and at international level in a Codex Alimentarius guideline. Since its inception, organic legislation has undergone a series of revisions. For example, the original regulation permitted the inclusion of genetically modified ingredients in organic food (Macmaoain 2007:264). In addition, a later amendment permitted the use of labelling ‘organic’ of foods that contained up to 30% of non-organic (Macmaoain 2007:264). Further, according to Macmaoain (2007:264) more than 40 amending regulations have created a significant challenge to those who wish to work in the framework developed by the EU. The introduction of the new EU organic logo and its accompanying regulation(s) aims to resolve the challenges created from the plethora of legislation in this area.


Figure 1 The ‘Euro leaf’ logo

The logo indicates that food fully conforms to the conditions and regulations for the organic farming sector set down by the European Union in Regulation (EC) 834/2007. There are three groups of products:

- Products which must be labelled with the logo
- Products which can be labelled voluntarily with the logo
- Products that cannot be labelled with the logo

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COM(2009) 234 final

72 The organic logo is required for pre-packed organic food products which are in the scope of Regulation 834/2007. Article 1 Directive 2000/13/EC defines a pre-packed organic food product as ‘any product which is put into packaging before being offered for sale (and presented) to the ultimate/final consumer or to mass caterers’. Article 25 (1) and Article 23 (4) of Regulation 834/2007 state that products must also contain at least 95% (by weight) ingredients from organic agricultural origin.
Regulation (EC) 834/2007 sets out the additional compulsory requirements relating to the labelling of organic products. These are:

- Indication of the place where the agricultural raw materials of which the product is made originate can be expressed in four ways: ‘EU Agriculture’, ‘non-EU Agriculture’, ‘EU/non-EU Agriculture’ and ‘XXXX-Agriculture’ (the latter represents an alternative option to EU or Non-EU).
- The code number of the control authority or control body (the company that was last to prepare, process or pack the product).
- Title III of Commission Regulation (EC) No 889/2007 lays down detailed rules on the implementation of Regulation (EC) No 834/2007. These include detailed information required for the code number and specific labelling requirements for feed.

The policy goals behind the labelling and logo scheme are stated in Council Regulation 834/2007:

- **Council Regulation 834/2007(1)** recognises the benefits of organic production and concludes that the organic production method ‘plays a dual societal role where it on the one hand provides for a specific market responding to a consumer demand for organic products, and on the other hand delivers public goods contributing to the protection of the environment and animal welfare, as well as to rural development’.
- **Council Regulation 834/2007(2)**: The regulation is in response to the significant growth in the organic sector in most Member States of the EU. Organic is considered to have a central role in the objectives of the CAP, in particular, the supply of quality food products to meet consumer demands and the establishment of fair competition in market of organic products.
- **Council Regulation 834/2007(3)** states that an aim of the regulation is to maintain and justify consumer confidence in products labelled as organic.
- **Paragraph 9 of Council Regulation 834/2007(9)** declares that GMOs (and products produced from or by GMOs) are incompatible with the concept of organic production and consumers’ perception of organic products. Consequently, the regulation states that GMOs should not be used in organic farming or in the processing of organic products.
- The EU report on Agricultural Product Quality suggests that the lack of mutual recognition between schemes is a further reason for the creation of an EU-wide logo. Concern was expressed that the market for organic food was divided along national lines and that as a consequence of mutual lack of recognition barriers in the market are created73.

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7.1.2 GMOs

Directive 2001/18/EC regulates labelling related to genetically modified organisms (GMOs). In addition, specific labelling for food containing, consisting of, or produced from GMOs is provided for in Regulation (EC) No 1829/2003. A Communication from the EU Commission detailing the EU strategy on life sciences and biotechnology states that the EU regulatory framework on GMOs and GM food and feed aim to do the following:

‘It aims to provide a high level protection of human health and the environment, legal certainty for operators, address public concerns, including ethical concerns, facilitate consumers’ choice, and thereby fosters further public confidence on the use of GMOs.74.

Thus, the EU recognises the consumers’ right to information and labelling as a tool to enable consumers to make an informed choice.

Section 2, Article 12 of Regulation 1829/2003 on genetically modified food and feed focuses on labelling of foods that contain or consist of GMOs or are produced from or contain ingredients produced from GMOs. Paragraph 2 of Article 12 of Regulation 1829/2003 states that the labelling requirements do not apply to food containing material, which consists of or is produced from GMOs in a proportion no higher than 0.9 % of the food ingredients considered. This exclusion is allowed if the presence of GMO is ‘adventitious or technically unavoidable’.

The labelling of GMO products relies on a dedicated system of traceability established by Regulation (EC) No1830/2003. Traceability is fundamental to the labelling of GMO products because some foods produced from GMOs (for example, some refined oils) do not differ from a physico-chemical point of view from products of non-GM origin. Traceability is also held within Regulation (EC) No1830/2003 as essential to establish accurate labelling of foods containing, consisting of or derived from ingredients containing GMOs. The aim of traceability established by Regulation (EC) No1830/2003 is ‘to ensure that accurate information is available to operators and consumers to enable them to exercise their freedom of choice in an effective manner as well as to enable control and verification of labelling claims’.

7.1.3 Novel foods

Regulation (EC) 258/97 concerns the placing on the market within the Community of novel foods and novel ingredients. The scope of the regulation includes but is not limited to GMOs.75.

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75 More specifically Article 1 of Regulation (EC) No 2065/2001 states: This Regulation shall apply to the placing on the market within the Community of foods and food ingredients which have not hitherto been used for human consumption to a significant degree within the Community and which fall under the following categories:
(a) foods and food ingredients containing or consisting of genetically modified organisms within the meaning of Directive 90/220/EEC;
(b) foods and food ingredients produced from, but not containing, genetically modified organisms;
(c) foods and food ingredients with a new or intentionally modified primary molecular structure
Transparency in the Food Chain

Regulation (EC) 258/97 lays down specific labelling arrangements for foods falling within the scope of the term 'novel'. In particular, Article 8 of Regulation (EC) 258/97 states that ‘the following additional specific labelling requirements shall apply to foodstuffs in order to ensure that the final consumer is informed of:

(a) any characteristic or food property such as:
- composition,
- nutritional value or nutritional effects,
- intended use of food,
which renders a novel food or food ingredient no longer equivalent to an existing food or food ingredient.

In such circumstance, labelling of food must indicate ‘the characteristics or properties modified, together with the method by which that characteristic or property was obtained’

An amendment on the proposal for regulation of novel foods was rejected by a majority of MEPS at the European Parliament in July 2010. The amendment required the mandatory labelling of food products which originate from animals fed and raised on GM-feedstuffs.

7.1.4 Fishery and aquaculture products

Regulation (EC) 104/2000 on the common organisation of the markets in fishery and aquaculture products details marketing and consumers information requirements for fish and seafood products. Specifically, chapter 2, Article 4 states that such products may only be offered for sale if the labelling indicates the following:

- The commercial name of the species
- The production method (caught at sea or inland waters or farmed)

(d) foods and food ingredients consisting of or isolated from micro-organisms, fungi or algae;
(e) foods and food ingredients consisting of or isolated from plants and food ingredients isolated from animals, except for foods and food ingredients obtained by traditional propagating or breeding practices and having a history of safe food use;
(f) foods and food ingredients to which has been applied a production process not currently used, where that process gives rise to significant changes in the composition or structure of the foods or food ingredients which affect their nutritional value, metabolism or level of undesirable substances.

76 Article 8, paragraph 1 continues (b) the presence in the novel food or food ingredient of material which is not present in an existing foodstuff and which may have implications for the health of certain sections of the populations;

(c) the presence in the novel food or food ingredient of material which is not present in an existing equivalent foodstuff and which gives rise to ethical concerns;

(d) the presence of an organism genetically modified by techniques of genetic modification, the non-exhaustive list of which is laid down in Annex I A, Part 1 of Directive 90/220/EEC.

• The catch area

A further piece of regulation - Regulation (EC) No 2065/2001 - lays down detailed rules of the implementation of Regulation (EC) 104/2000 was adopted by the Commission. Article 4, paragraph 1 states that the precise definitions of terms to be used in labelling to describe the production method process must be one of the following terms – ‘caught’...‘caught in freshwater’ ...‘farmed’ or ‘cultivated’ (Article 4 (1)).

7.1.5 Summary: Environment (PPM)
The policy aims behind the legislation are as follows:

• to indicate process production methods (PPMs) of foods to consumers and thus enable consumer knowledge, choice and confidence. The PPMs include GMO, organic, novels foods and the catch methods of fishery and aquaculture products.
• to remedy and addresses the market divisions created by national-based certification schemes (for example, with organic production and the creation of an EU based logo)

7.2 Environment: impacts
The signalling of the environmental impact(s) of food and food production to consumers through private industry and NGO promoted voluntary labelling and logos based on certification schemes is quite extensive and is covered in chapter 2.3 of this book. The private labelling and certification schemes are ahead of the EU regulation. However, EU policy objectives are seeking to address this situation. The main EU regulation currently dealing with these dimensions is the Ecolabel, which is also a voluntary scheme. The logo and labelling schemes that are linked to environmental impact and standards match the EU’s policy agenda intentions on sustainability.

7.2.1 EU Ecolabel
On the 25 November 2009 the European Council and Parliament adopted Regulation (EC) No 66/2010 on the EU Ecolabel. The EU Ecolabel is a voluntary scheme, which aims to promote goods whose entire lifecycle has a reduced environmental impact. The provision of accurate science-based information regarding the environmental impact of goods to the consumer is also a key aim of the regulation.

The EU Ecolabel scheme is driven by a broader sustainable and consumption policy adopted by the EC. The sustainable and consumption policy of the EC aims at ‘reducing the negative impact of consumption and production on the environment, health, climate and natural resources’78.

The EU Ecolabel was established in 1993 and latest figures up to 30/06/2010 reveal that 1064 companies are licensed to use the EU Ecolabel and therefore meet the criteria of the scheme79. The

78 Regulation (EC) No 66/2010 on the EU Ecolabel (IV) para 5.
79 http://ec.europa.eu/environment/ecolabel/about_ecolabel/facts_and_figures_en.htm#facts
growth of the EU Ecolabel scheme has resulted in an increase in the number of product groups covered by the scheme. Examples of product groups range from clothing and cleaning products to furniture, gardening and household appliances. A specific compliance criterion exists for each product group.

Until the introduction of Regulation (EC) No 66/2010 food products were excluded from the Ecolabel. The regulation signals the intention of the EC to extending the Ecolabel scheme to include the category of food. One motivation is to avoid the proliferation of and, segmentation of, environmental schemes. It also signifies recognition by the EC of the environmental impact of the consumption and production of food. The regulation limits the inclusion of food as a product category of the scheme with its stipulation that a study to ensure that feasible criteria is undertaken. The study will also explore the possibility of eligibility of food products for the EU Ecolabel being dependent on them being certified as organic (as detailed set out by Regulation (EC) No 834/2007). This approach indicates awareness by the EU of the potential need to extend food labelling in this area.

7.2.2 High-Nature Value Farming Scheme

The EU has discussed a proposal for a quality label for high-nature value (HNV) farming. ‘High-nature value farming’ refers to the environmental value of a specific area and to the farming on which that value depends. The geographical areas captured by the definition of HNV farming are mostly semi-natural grasslands and mountainous areas. In these areas, farming is considered a marginal and often lacks economic success but the farming remains an important activity in its role in maintaining biodiversity conservation and habitats protection.

While some effort into the preservation of such farming activity exists, through CAP rural development programmes for example, the EU agricultural product quality policy paper states that the intention of quality level for HNV farming. This would be to allow farmers to access greater marketing opportunities and for consumers to purchase products which benefits farmers and contributes to sustainability (through maintaining biodiversity conservation and habitats protection).

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80 Regulation (EC) No 66/2010 IV(6)
81 The deadline for the call for tender is July 26 2010. Consequently, the result of the eligibility study is not expected in the near future.
Policy drivers for a scheme for products of high nature value farming:

- Biodiversity relies on the extensive farming systems and environmental service provided by farmers in these areas
- CAP support is insufficient for these farmers, consequently the viability of these farms are at risk
- Some consumers may be willing to buy products, which offer benefits and support farmers and the farming systems upon which the conservation of biodiversity rests.
- The introduction of such a scheme would prevent the misleading of consumers for example, especially regarding where a product has been made e.g. in mountainous areas.
- Farmers would benefit from the introduction of such a scheme which would , it is hoped, increase the economic sustainability of farmers who produce in these areas.

Issues identified that need to be explored before the introduction of the scheme include:

- The identification of criteria and characteristics of farming techniques which create high nature value farming;
- Discussion of the most appropriate level of such a scheme, including, for example justification for scheme at EU level;
- Awareness of how a scheme might impact or complement existing policies in this area e.g. rural development policy.85

7.2.3 Further policy initiatives on signalling the environmental impact of food

One example of an EC supported initiative exploring approaches to sustainability methodologies and food is the ‘The European Food Sustainable Consumption and Production Round Table’ (FSCPRT). The roundtable aims to establish scientifically reliable environmental assessment methodologies for food (and drinks). In addition, the FSCPRT seeks to identify suitable tools and guidance for voluntary environmental communication to consumers and other stakeholders86. The EU has indicated that a future aim is to consolidate approaches to calculating carbon footprint and eventually create a common approach. ‘In its Council Conclusions of 4.12.2008 concerning “Sustainability Consumption and Production and Sustainable Industrial Policy Action Plan”, Council invited the Commission:87

- “to study the introduction of the carbon footprint of products in the existing EU environmental labelling instruments such as the Eco-label and energy labelling; also invites the Commission, taking into account Member States’ experience, to start working as soon as


86 http://www.food-scp.eu/

possible on common methodologies facilitating the future establishment of carbon audits for organisations and the calculation of the carbon footprint of products."

- The key challenge here will be to develop a label that reflects the environmental burden resulting from a particular product. In doing so however, it is likely that the two comparable or of same products might create a different environmental burden. This is because of the array of variables that affect the potential environmental burden of a product (e.g. weather, transport, storage, packaging, production technique, region of production). These variables are subject to change; consequently, analysis upon which consumers can rely upon is potentially expensive and complicated.

### 7.2.4 Packaging


Article 8 creates the requirement for the marking and identification system for packaging and aims to facilitate ‘the collection, reuse and recovery including recycling’. Annex I of the directive sets out the format of the identification system which is based on numbering and abbreviations. In addition, packaging must display the apposite marking in a visible and legible format. Thus, the system set in place under the directive is technical and aimed towards those who are responsible for the management of packaging and packaging waste. Absent from the directive is guidance for consumers on the environmental claims linked to packaging.

A common logo used to indicate information about recycling and packaging is the Möbius loop (Palerm, 2000:12). ISO requirements govern the use of the Möbius loop recycling logo. The absence of specific regulation in this area reflects the reliance on ISO to govern the signals linked to environmental claims on packaging.

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89 Annex I of EC Directive on Packaging and Packaging Waste 94/62/EC sets out the identification system for packaging as follows: The numbering used shall be from 1-19 for plastic, from 20-39 for paper and cardboard, from 40-49 for metal, from 50-59 for wood, from 60-69 for textiles and from 70 to 79 for glass. The identification system may also be use the abbreviation for the relevant material(s) (e.g. HDPE: high density polyethylene). Materials may be identified by a numbering system and/or abbreviation. The identification marks shall appear in the centre of or below the graphical marking indicating the reusable or recoverable nature of the packaging.

90 The Möbius loop, according to Palerm, can be used to signal different messages regarding environmental claims. For example, the logo can denote the packaging is made from recycled materials or can be recycled after use. In the case of the former, the logo must be accompanied by statement indicating the percentage of the recycled material (Palerm, 2000:12). According to Palerm, section 7 of ISO 14021:1999 specifies the requirements for a range of environmental claims including: compostable, degradable, recyclable, reduced water consumption.
Cooperation between retailers and national governments has resulted in the development of logos which aim to communicate information concerning household recycling to consumers. An example from the UK is the recycling label launched by the British Retail Consortium. With support from the Waste and Resources Action Programme (Wrap), the label was launched in 2009. The label attempts to deal with the complexity of recycling by indicating which part of the packaging can be:

- widely recycled
- sometimes recycled (dependent upon local authority recycling facilities)
- not currently recycled

An aim of the labels’ creators is to contribute to the increase of recycling and thus meet environmental and recycling targets.

### 7.2.5 Summary

The rapid spread of labels and certification schemes addressing aspects of the environmental impacts of food products on their journey to the retailers’ shelf including the PPMs have not been reflected in more specific deployment as a policy instrument in EU legislation. The main legislation- the EU Ecolabel does not cover food products to date.

However, in policy communications from the European Commission and some of its stakeholder advisory bodies, aspects such as carbon impacts and biodiversity impacts have been suggested as areas needing further development, including agreements on the methodologies required for preparation of the signalling of such impacts associated with specific food products to consumers. Such policy intentions remain as an aspiration at present but they are moving up the agenda. Further issues such as water impacts are likely to follow as well.

Systems of marking and identification for packaging and packaging waste are established by EU legislation (see 6.2.5). EU legislation in this area however is aimed primarily at those responsible for the management of packaging and packaging waste. Further, the existing legislation does not offer information and guidance on environmental claims linked to packaging. Instead, consumers rely on private regulation such as the ISO requirements.

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91 [http://www.designcouncil.org.uk/about-design/Types-of-design/Packaging-design/Sustainability/]
8 Ethical and Social

8.1 Animal welfare

Animal welfare standards in the EU date back to 1974 when the first legislation in this area was adopted\(^92\). The EU recognised that animals are sentient beings in the Protocol to the EC Treaty on the Protection and Welfare of Animals (in force since 1999)\(^93\). A goal of the EU is the promotion of improved and better welfare standards internationally\(^94\). Earlier legislation on animal welfare reflects the EU concern that competition between producers may be distorted if different levels of welfare exist. Macmaoain (2007:265) illustrates this point:

‘If Member State A sets low standards for animal welfare protection in its national law but Member State B requires that animals reared for food production must be well housed, fed and spend time outdoors, Member State A is able to produce food at a lower cost, distorting competition between Member States.’

The EU has adopted legislation which contains measures relating to the protection and welfare of animals covering farming, transport and slaughter yet no harmonised requirements exist for the labelling of animal welfare standards. In this section, we set out the policy incentives towards using labelling in this area and the barriers that exist for the emergence of a EU wide animal welfare label.

8.1.1 Policy goals of animal welfare labelling

In October 2009, the European Commission adopted a report which put forward options for animal welfare labelling\(^95\). The policy goals seek to:

- Enable consumers to easily identify and choose welfare-friendly products
- Provide an economic incentive for producers to improve the welfare of animals

8.1.2 Policy drivers of animal welfare labelling

- Response to consumer demand
  The drive towards animal welfare labelling is a response to consumers’ concern about the treatment of animals and requests for greater indicators of good animal welfare standards on food labels.

- ‘Win-Win’ scenario


\(^93\) Factsheet: Animal Welfare March 2007 Health and Consumer Protection Directorate-General European Commission

\(^94\) Factsheet: Animal Welfare March 2007 Health and Consumer Protection Directorate-General European Commission

A ‘win-win’ scenario is proposed with the signalling of better information to consumers about animal welfare. Consumers purchasing food products that are subject to improved animal welfare will create a demand which will, in turn, result in an increase in improved animal welfare. Suppliers may be able to receive a premium price and in doing so recover a portion of any associated costs with implementing and adhering to better animal welfare standards.96

- Assurance and verification
Consumers wish to be reassured that the welfare of animals is upheld. Labelling is an important tool in this context because consumers are unable to verify at the point of sale that animal welfare protection has been maintained in the process and production of food.97 Labelling provides a useful and understandable format in which to communicate information on welfare standards.98

- Distinction between EU and non-EU food
The EU considers that the use of labelling will prevent the higher standards of welfare being undermined by non-EU food products which are not subject to the equivalent levels of animal welfare standards. In relation to WTO law, the development of a labelling scheme would be allowed if voluntary. An obligatory labelling scheme, according to Commission, has the potential to cause controversy. With regards to the impact of a voluntary labelling scheme on non-EU countries, the Commission considers that the impact ‘would probably be positive for countries already considering sustainable forms of animal production and for production derived from less intensive forms of animal keeping’99. Examples of benefits cited are better market access and the possibility of long-term planning investments. The importance of considering the impact of a scheme on developing countries is also underlined.

### 8.1.3 Barriers to animal welfare labelling
An absence exists on the methods of how to comprehensively assess animal welfare. As yet, ‘there is no harmonised, recognised, and reliable measuring instrument for comprehensively assessing animal

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98 ‘Labelling: competitiveness, consumer information, better regulation for the EU’

A DG Sanco Consultative Document paragraph 34

welfare across species, farming systems and supply chain stages available\textsuperscript{100}. In response to this problem, the EU created the “Welfare Quality” project which aimed to investigate the development of animal based scientific indicators. One outcome of such a project is the creation of a system which is ‘based not on production method, but on animal-based outcomes to classify animal welfare’\textsuperscript{101}. Fundamental to animal welfare labelling systems is the assessment of animal welfare at all relevant stages: farming, transport and slaughter\textsuperscript{102}.

The proposal for a regulation on the provision of food information introduced the requirement for the labelling of ritually slaughtered meat. Often, slaughter without stunning occurs as a consequence of following religious practices, such as Kosher and Halal. The aim behind the introduction of the label is primarily to ensure consumers can exercise choice between meat which has been stunned in the process of slaughter and meat which has not. The aim behind the label was to allow greater transparency on the processes of animal welfare protection. If the proposal becomes a regulation, meat from slaughter without stunning will be labelled as 'Meat from slaughter without stunning'\textsuperscript{103}.

\textbf{8.1.4 Animal welfare and the labelling of eggs}

\textit{Council Directive 1999/74/EC} lays down the minimum standards of welfare for laying hens and \textit{Council Regulation 1028/2006/EC} and \textit{Commission Regulation 557/2007/EC} sets out the rules for marketing eggs and the measures for implementation. Legislation on egg marketing governs how EU egg producers are required to label eggs sold to consumers. The labelling of eggs signals to consumers the type of production system used by producers. The labelling scheme is thus based on the presumed welfare outcomes of each production method.

\textit{Article 3 of Council Regulation 1028/2006/EC} states that eggs must be graded by quality as either Class A ‘fresh’ or Class B. \textit{Article 2 of Commission Regulation 557/2007/EC} sets out the quality characteristics for Class A eggs. All eggs which do not meet quality criteria set out in Article 2 are graded as Class B. In addition, Article 4 states that Class A eggs must be graded by weight (XL, L, M, S). Article 12 stipulates the terms that can be used for the identification of farming methods of eggs.

\textsuperscript{100} Report: Feasibility study on animal welfare labelling and establishing a Community Reference Centre for Animal Protection and Welfare Part 1: Animal Welfare Labelling


\textsuperscript{103} Amendment 205 Proposal for a regulation on the provision of food information Annex III – table - row 1 a (new)
These are ‘free range eggs’, ‘barn eggs’, ‘eggs from caged hens’ or ‘organic’. Regulation exists on
the method for indicating how laying hens are fed (See Article 15). Article 12 also refers to Annex I & II
for the minimum standard of production required for each.

8.2 Labour and working conditions
No specific label or logo exists on the topic of labour and working conditions. The issue of labour and
working conditions is addressed by standards set out in private certification schemes, for example, fair
trade. Article 6, paragraph 3(c) of Regulation (EC) No 66/2010 (on the EU Ecolabel) makes
limited to reference social and ethical aspects of production as part of the criteria required for the
EU Ecolabel. As discussed in section 6.2.3 of this chapter, however, the EU Ecolabel does not as yet
cover food products.

8.3 Terms of trade
This section focuses specifically on fair trade. Fair trade defined by a partnership, based on dialogue,
transparency and respect, and one which seeks greater equity in international trade.

Expectations of fair trades schemes have been made apparent by several EU institutions. For
example, in 1999, a communication from the EU called for a single label for fair trade. A more recent
communication acknowledges the development and implementation of the ‘Fairtrade Certification
Mark’ since 1999. More broadly, Fair trade and similar schemes (such as Rainforest Alliance which
covers environmental and social aspects) are recognised to contribute to the sustainable
development – an aim that is held by the EU.

In the recent communication adopted by the EU/EC, the Commission stated that it should not have a
role in ‘ranking of regulating criteria related to private trade-related sustainability assurance
schemes, and their relevance in relation to sustainable development objectives’. This is because
the EU recognises that Fair Trade and other similar schemes are a ‘voluntary, dynamic mechanism
that develops along with societal and consumer awareness and demands’. Regulating these

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105 Communication: Contributing to Sustainable Development: The role of Fair Trade and non-governmental
trade-related sustainability assurance schemes Brussels, 5.5.2009

COM(2009) 215 final p4

106 Communication: Contributing to Sustainable Development: The role of Fair Trade and non-governmental
trade-related sustainability assurance schemes Brussels, 5.5.2009p6

COM(2009) 215 final

107 Communication: Contributing to Sustainable Development: The role of Fair Trade and non-governmental
trade-related sustainability assurance schemes Brussels, 5.5.2009p6

COM(2009) 215 final
initiatives, according to the communication, might impact upon the dynamic and future development of schemes in this area.

The Commission has acknowledged the success of the schemes in terms of consumer awareness and uptake and stated clearly the need to retain the autonomy of the schemes. In doing so, it maintains an advisory position in relation to the schemes. In this capacity, the Commission has set down some principles to ensure the maximisation of the impact of private trade-related sustainability schemes, such as fair trade. These are:

- Maintaining the non-governmental nature of private schemes throughout the EU;
- Exploring the scope for possible synergies between schemes and enhancing clarity for the consumer and producers;
- Achieving a common understanding of reasonable basic process requirements;
- Establishing objectives facts on the relative impacts of different private trade-related sustainability assurance schemes.

The Commissions’ approach to terms of trade, in the context of fair trade, is one which seeks to maintain a balanced role in which the Commission acknowledges and supports the role of fair trade and other similar schemes in their efforts to highlight and communicate to consumers on issues and understandings of sustainable development. The Commission however also seeks to encourage work by schemes and non-governmental organisations involved in this area to ‘work towards a common understanding of what basic process requirements it is reasonable to expect schemes to meet, while continuing to avoid entering into defining appropriate sustainability standards for private schemes’.

### 8.4 Social and Community Capital

A number of logos and labels already discussed and referenced in this chapter seek to contribute to the creation of social and community capital for example fair trade. One potential outcome of the HNV farming scheme is the maintaining of social and community capital (see section 7.2.2). Similarly, social and community capital has the potential to be enhanced through the existence of PDO and PGI schemes (see section 6.1).

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108 E.g. ‘The consumer recognition of the Fair Trade mark in the UK was above 70% in 2008 (compared to 12% in 2000) and in France 74% in 2005 (compared to 9% in 2000). Worldwide sales of certified Fair Trade goods exceeded €2.3 billion by the end of 2007. From P4 Communication: Contributing to Sustainable Development: The role of Fair Trade and non-governmental trade-related sustainability assurance schemes Brussels, 5.5.2009

COM(2009) 215 final

109 Communication: Contributing to Sustainable Development: The role of Fair Trade and non-governmental trade-related sustainability assurance schemes Brussels, 5.5.2009

COM(2009) 215 final p8

110 Communication: Contributing to Sustainable Development: The role of Fair Trade and non-governmental trade-related sustainability assurance schemes Brussels, 5.5.2009p7

COM(2009) 215 final
8.5 Cultural and Social – PPM
Examples in this category include the labelling of Kosher, Halal and vegetarian foods. The proposal for a regulation on the provision of food information details requirements in which meat from slaughter without stunning, a process that is a consequence of following certain religious traditions should be labelled as 'Meat from slaughter without stunning' (see section 8.1.3).
Article 35 of the proposal for a regulation on the provision of food information defines the context in which the terms ‘vegetarian’ and ‘vegan’ may be used. The term vegetarian should not be applied to:

Foods that are made from or with the aid of products derived from animals that have died, have slaughtered or with the aid of products derived from animals that have died, have been slaughtered, or animals that die as a result of being eaten

Article 35 states that the term vegan should not be applied to foods that are:

made from or with the aid of, animals or animal products (including products from living animals).

The labelling of foods which are appropriate for kosher, halal or vegetarian based diets enables consumer confidence and protection.

8.6 Summary
• The use of animal welfare related food transparency schemes is considered to have the potential to enable greater consumer choice. In addition, animal welfare related food transparency schemes provide an incentive to improve welfare of animals because of the greater returns available to producers who comply with animal welfare standards.
• A barrier exists towards the use of EU based animal welfare label because of the methodological approach sought that is based on animal behavioural outcomes rather than production process organisation.
• Food transparency schemes do not feature as a tool to meet policy and regulatory goals linked with the improvement of labour and working conditions in the food sector.
• The improvement of terms of trade for producers is central to sustainable development policy of the EU. In this chapter, policy documents reveal that the European Commission seeks to respect the autonomy and success of privately (NGO and CSO orientated) initiated food transparency schemes working in this area. Consequently the Commission maintains an advisory position on aspects such as the provision of information concerning the impacts of food transparency schemes and ensuring clarity for both consumers and producers.

111 Amendment 205 Proposal for a regulation on the provision of food information Annex III – table - row 1 a (new)
112 Amendment 175 of the proposal for a regulation on the provision of food information
• The creation of social and cultural capital is a policy aim in which food transparency schemes are held by the EU to play a significant role. Such schemes include the Higher Value Farming scheme and Geographical Indicator based schemes.

• Social and cultural based food transparency schemes that enact goals of ensuring consumer choice and confidence include the reliance on halal, kosher and vegetarian oriented schemes.

9 Conclusion
This chapter has sought to identify the policy areas in which labelling, in particular logos (and the food transparency schemes that underpin them) are used as an as an instrument of public policy by the EU.

Primarily, the policy aim behind the use of labelling is to enable consumer choice, trust and confidence in the food sold across the EU. Food transparency schemes are also considered a tool in which enable greater benefits for producers – which is a further policy goal held by the EU. Foods labelling which seeks to inform consumers about the nutritional composition of foods reflect the belief in the role of labelling to contribute towards specific policy goals linked to health and obesity. In addition, the development of food transparency schemes in relation to environmental impacts and production process methods are considered a) a sufficient response to consumer demand b) to have the potential to provide benefits for producers and c) to contribute towards policy goals around sustainability.

Directive 2000/13/EC which sets out the basic expectation and requirement of labelling (e.g. to provide clarity and not mislead consumers) is being revised and already has been effectively supplemented by the development of subsequent legislation as a result of a) the consolidation of marketing standards regulation and b) the development of EU based food transparency schemes. These legislative and policy developments strongly suggest that the area of labelling is complex and changing. One example of change is how the meaning and understanding of food quality is emerging from a narrow definition linked to food composition to one which is inclusive of particular farming attributes, such as environmental impact of production process methods. Such goals are broad and all encompassing but in this chapter are categorised under the three sections of 1) Food Safety 2) Food Quality and 3) Food (chain) Integrity.

While food transparency schemes and their associated labels and logos are recognised as a key instrument in which to achieve policy goals, key challenges remain in several policy areas concerning their use. The first relates to the extent to which labels, logos and certification schemes should be mandatory or remain voluntary. In addition, it is apparent that in some key policy areas that the further use of food transparency schemes is limited due to methodological and technological barriers.
This chapter has detailed the areas in which food transparency schemes are used to implement and shape policy goals and outcomes yet further questions exist. These concern the following:

- An assessment of the extent to which food transparency schemes have met expectations indicated by public policy statements and legal requirements requires an evaluation of consumer understanding of logos, labels and certification schemes. This is addressed by in the book covering chapter 3.2.

- Stakeholders’ perceptions of the strengths and weakness of logos and labels to signal information to consumers can also be used to assess the effectiveness of the policy-based and regulatory approach to transparency in this context that is addressed in chapter 3.1.
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343


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Transparency in the Food Chain


Which online (2010): Making Sustainable Food Choices Easier


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Barling D., Chryssochoidis G., Simpson D., Kehagia, O., 2011., Transparent_Food D5.4 Final summary report integrating findings from Tasks 5.1 5.3 in terms of research needs
Chrysochoidis G., Kehagia O., 2010., Transparent_Food D5.2 A meta-analytic roadmap of consumer requests, contexts for such requests and priorities.


Knorr D., Jäger H., Surowsky B., (2010), Transparent_Food D3.4 Analysis of deficiencies (weaknesses) within traditional food processing, of improvement opportunities through process optimization or emerging technologies, and of feasibility regarding industrial implementation.


Östergen, K., Sonesson U., 2011, Transparent_Food D4.4 Analysis of deficiencies (weaknesses) within traditional food processing, of improvement opportunities through process optimization or emerging technologies, and of feasibility regarding industrial implementation.


Schiefer G., Fritz M., 2010b, Transparent_Food D7.2 Focus guide on transparency, tracking, tracing, sustainability and integrity.


Simpson D., Barling D., 2010, Transparent_Food D5.1 Report drawn from data collection and review and stakeholder participant workshops on the breadth and range of certification systems and labelling schemes signalling information to consumers and the strengths and weaknesses of these systems and signals.

Simpson D., Barling D., 2010., Trasparent_Food D5.3 Report of analysis public policy statements and legal requirements and expectations of food transparency schemes and their role in achieving policy and regulatory goals.

UGent (in collaboration with CCH, the members of the Traspertant_Food consortium and the WP6 working group), 2011., Transparent_Food D6.2 Analysis of selected experiences of ‘best practice transparency solutions’ in enterprises and food chains.

UGent (in collaboration with CCH and the members of the Transparent_Food Consortium), 2010., Transparent_Food D6.1 Topics, performance indicators, and template for analysis of best practice experiences.
ACKNOWLEDGMENT

This research has been supported by the European Commission through its FP7 program and the project Transparent_Food (*Quality and integrity in food: a challenge for chain communication and transparency research*), project/contract number 245003.
Appendix 1

Authorlist and Consortium
## AUTHORSHIP AND RESPONSIBILITY FOR THE INDIVIDUAL CHAPTERS

<table>
<thead>
<tr>
<th>Chapters</th>
<th>Lead scientists</th>
<th>Group members</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I INTRODUCTORY PART</strong></td>
<td>G. Schiefer (UBO)</td>
<td>J. Deiters (UBO)</td>
</tr>
<tr>
<td><strong>II INFORMATION PART</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Food Safety</td>
<td>H. Hofstra (SAFE), T. Hogg (SAFE)</td>
<td></td>
</tr>
<tr>
<td>B Food Quality</td>
<td>D. Knorr (TUB)</td>
<td>H. Jäger (TUB), B. Surowsky (TUB)</td>
</tr>
<tr>
<td>C Food Chain Integrity</td>
<td>J. Hermansen (AU), K. Oestergren (SIK), U. Sonesson (SIK), N. Halberg (ICROFS)</td>
<td>K. Lorentzon (SIK), L. Jespersen (AU), D. Barling (City), D. Simpson (City)</td>
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<tr>
<td><strong>III COMMUNICATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Certification systems and labelling schemes signalling information to consumers</td>
<td>D. Barling (City)</td>
<td>D. Simpson (City)</td>
</tr>
<tr>
<td>B Consumer requests, contexts for such requests and priorities</td>
<td>G. Chryssochoidis (RLabs)</td>
<td>O. Kehagia (RLabs)</td>
</tr>
<tr>
<td><strong>IV BEST PRACTICE</strong></td>
<td>X. Gellynck (UGent)</td>
<td>A. Molnar (UGent), K.v. Lembergen (UGent), M. Bozic (UGent), A. Berczeli (CCH), F. Homolka (CCH)</td>
</tr>
<tr>
<td>A Sebök (CCH)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>V CARRIERS OF TRANSPARENCY</strong></td>
<td>M. Kunisch (KTBL)</td>
<td></td>
</tr>
<tr>
<td>D. Martini (KTBL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VI POLICY STATEMENTS AND LEGAL REQUIREMENTS</strong></td>
<td>D. Barling (City), G. Schiefer (UBO).</td>
<td>D. Simpson (City), J. Deiters (UBO)</td>
</tr>
</tbody>
</table>
CONSORTIUM

Department for Food and Resource Economics, University of Bonn (UBO) — Germany

Kuratorium für Technik und Bauwesen in der Landwirtschaft e. V. (KTBL) — Germany

Department of Food Biotechnology and Food Process Engineering, Technische Universität Berlin (TUB) — Germany

The European Association for Food Safety (SAFE) — Belgium

The Swedish Institute for Food and Biotechnology AB (SIK) — Sweden

Faculty of Agricultural Sciences, University of Aarhus (AU) — Denmark

Centre for Food Policy, City University London (City) — United Kingdom

RLabs Market Research Ltd. (RLabs) — Greece

Faculty of Bio-engineering, Department of Agricultural Economics, Ghent University (UGent) — Belgium

Campden BRI Magyarország Nonprofit Kft (CCH) — Hungary
Appendix 2

## Food Safety and Food Quality (composition)

<table>
<thead>
<tr>
<th>Regulation/Directive No.</th>
<th>Title</th>
<th>Date</th>
</tr>
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<tbody>
<tr>
<td>Regulation (EC) 178/2002</td>
<td>Laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matter of food safety</td>
<td>28 January 2002</td>
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<tr>
<td>Regulation EC 1333/2008</td>
<td>On food additives</td>
<td>16 December 2008</td>
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## Food Quality (health and nutrition)

<table>
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<tr>
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<th>Title</th>
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<tbody>
<tr>
<td>Regulation (EC) No 1924/2006</td>
<td>On nutrition and health claims made on foods</td>
<td>20 December 2006</td>
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</table>
## Origin (referring to place, region and country)

<table>
<thead>
<tr>
<th>Regulation/Directive No.</th>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulation (EC) 510/2006</td>
<td>On the protection of geographical indications and designations of origin for agricultural products and foodstuffs</td>
<td>20 March 2006</td>
</tr>
<tr>
<td>Regulation (EC) 509/2006</td>
<td>On agricultural product and food stuffs as traditional specialities guaranteed</td>
<td>20 March 2006</td>
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</table>

## Environment

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<thead>
<tr>
<th>Regulation/Directive No.</th>
<th>Title</th>
<th>Date</th>
</tr>
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<tbody>
<tr>
<td>Regulation (EC) 258/97</td>
<td>Concerning novel foods and novel foods ingredients</td>
<td>27 January 1997</td>
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### Transparency in the Food Chain

<table>
<thead>
<tr>
<th>Regulation/Directive No.</th>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
</table>

**Ethical and Social**

<table>
<thead>
<tr>
<th>Regulation/Directive No.</th>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulation 1028/2006/EC</td>
<td>On marketing standards for eggs</td>
<td>19 June 2006</td>
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List of proposals of regulations

<table>
<thead>
<tr>
<th>Proposal title</th>
<th>Stage</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>the provision of food information</td>
<td></td>
<td>COM(2008) 40 final</td>
</tr>
</tbody>
</table>

| Proposal for a regulation of the European Parliament and of the Council on   |                                            |                                           |
| the provision of food information                                            |                                            |                                           |
Appendix 3

Table of stakeholders within the Part III
### Table of stakeholders within the Chapter 3

<table>
<thead>
<tr>
<th>Stakeholder Number</th>
<th>Description of stakeholder</th>
</tr>
</thead>
<tbody>
<tr>
<td>S#1</td>
<td>Certification scheme owner (with producer and food chain focus)</td>
</tr>
<tr>
<td>S#2</td>
<td>Global manufacturer</td>
</tr>
<tr>
<td>S#3</td>
<td>Global accreditation organisation (of certification schemes)</td>
</tr>
<tr>
<td>S#4</td>
<td>CSO-NGO (animal welfare focus)</td>
</tr>
<tr>
<td>S#5</td>
<td>Certification scheme owner (sustainable-agriculture focus)</td>
</tr>
<tr>
<td>S#6</td>
<td>Independent consultant (retail experience)</td>
</tr>
<tr>
<td>S#7</td>
<td>Global retailer and industry led organisation (German-based)</td>
</tr>
<tr>
<td>S#8</td>
<td>UK Retailer</td>
</tr>
<tr>
<td>S#9</td>
<td>UK Retailer</td>
</tr>
<tr>
<td>S#10</td>
<td>Certification scheme owner (ethical and social focus)</td>
</tr>
<tr>
<td>S#11</td>
<td>Retailer and industry led organisation (Sweden)</td>
</tr>
<tr>
<td>S#12</td>
<td>Certification scheme owner (producer level focus)</td>
</tr>
<tr>
<td>S#13</td>
<td>Civil Society Organisation (consumer focus)</td>
</tr>
</tbody>
</table>
Appendix 4

List of certification schemes and their associate logos
<table>
<thead>
<tr>
<th>Certification Scheme</th>
<th>Primary Aims</th>
<th>Secondary Aims</th>
<th>Signals: Logo</th>
<th>Source of Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assured Food Standards</td>
<td>Food safety</td>
<td>Origin (traceability)</td>
<td>[Logo]</td>
<td><a href="http://www.ndfas.org.uk/">http://www.ndfas.org.uk/</a></td>
</tr>
<tr>
<td>Incorporating:</td>
<td></td>
<td>Standards are wide ranging and include food safety, traceability, animal health and welfare, and environmental protection</td>
<td></td>
<td><a href="http://www.assuredcrops.co.uk/crops/home.eb">http://www.assuredcrops.co.uk/crops/home.eb</a></td>
</tr>
<tr>
<td>- Assured Combinable Crop</td>
<td></td>
<td></td>
<td></td>
<td><a href="http://www.assuredproduce.co.uk/ap/">http://www.assuredproduce.co.uk/ap/</a></td>
</tr>
<tr>
<td>- Assured Chicken</td>
<td></td>
<td></td>
<td></td>
<td><a href="http://www.assuredpigs.co.uk/pigs/">http://www.assuredpigs.co.uk/pigs/</a></td>
</tr>
<tr>
<td>- Assured British Pigs</td>
<td></td>
<td></td>
<td></td>
<td><a href="http://www.britishturkey.co.uk/">http://www.britishturkey.co.uk/</a></td>
</tr>
<tr>
<td>- Quality British Turkey</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Potato Assurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laid in Britain</td>
<td>Food Safety</td>
<td>Regional and local origin</td>
<td>[LIB logo]</td>
<td><a href="http://www.laidinbritaineggs.co.uk/index.htm">http://www.laidinbritaineggs.co.uk/index.htm</a></td>
</tr>
<tr>
<td>Lion Eggs</td>
<td>Food Safety</td>
<td>Origin (traceability)</td>
<td>[Lion Eggs logo]</td>
<td><a href="http://lioneegs.co.uk/page/lionmark">http://lioneegs.co.uk/page/lionmark</a></td>
</tr>
<tr>
<td>FEMAS (Feed Materials Assurance Scheme)</td>
<td>Food safety</td>
<td></td>
<td></td>
<td>no website</td>
</tr>
<tr>
<td>Certification Scheme</td>
<td>Primary Aims</td>
<td>Secondary Aims</td>
<td>Signals: Logo</td>
<td>Source of Signal</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------</td>
<td>----------------</td>
<td>---------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Eblex</td>
<td>Quality (organoleptic)</td>
<td>Origin</td>
<td><img src="http://www.simplybeefandlamb.co.uk" alt="Quality Standard beef logo" /></td>
<td><img src="http://www.simplybeefandlamb.co.uk" alt="Logo" /></td>
</tr>
<tr>
<td></td>
<td>Origin</td>
<td>Food Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Traceability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality Assured Farming Venison</td>
<td>Origin</td>
<td>Economic and Environmental Sustainability</td>
<td><img src="http://www.fedfa.com/quality.htm" alt="Quality Assured Farming Venison logo" /></td>
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</tr>
<tr>
<td></td>
<td>Quality (organoleptic)</td>
<td>Food safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality Meat Scotland</td>
<td>Origin</td>
<td>Standards and aims are specific to production stage(s)</td>
<td><img src="http://www.qmscotland.co.uk/" alt="Quality Meat Scotland logo" /></td>
<td><img src="http://www.qmscotland.co.uk/" alt="Quality Meat Scotland logo" /></td>
</tr>
<tr>
<td></td>
<td>Quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linking Environment and Farming</td>
<td>Environmental Production Process Method - Integrated farm Management</td>
<td>Origin(Traceability)</td>
<td><img src="http://www.leafuk.org/leafuk/" alt="Linking Environment and Farming logo" /></td>
<td><img src="http://www.leafuk.org/leafuk/" alt="Linking Environment and Farming logo" /></td>
</tr>
<tr>
<td>Organic Milk for Life</td>
<td>Production Process Method - Organic</td>
<td>Quality</td>
<td><img src="http://www.omsco.co.uk/index.cfm/e/about.home" alt="Organic Milk for Life logo" /></td>
<td><img src="http://www.omsco.co.uk/index.cfm/e/about.home" alt="Organic Milk for Life logo" /></td>
</tr>
<tr>
<td></td>
<td>Animal welfare</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certification Scheme</td>
<td>Primary Aims</td>
<td>Secondary Aims</td>
<td>Signals: Logo</td>
<td>Source of Signal</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------------------------</td>
<td>-----------------------------------------</td>
<td>----------------------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Marine Stewardship Council</td>
<td>Environment Natural Resource Management (sustainable fish stocks, environmental impact) *does not include farmed fish</td>
<td>Origin (boat to plate traceability)</td>
<td><img src="http://www.msc.org/" alt="Marine Stewardship Council Logo" /></td>
<td><a href="http://www.msc.org/">http://www.msc.org/</a></td>
</tr>
<tr>
<td>Halal Monitoring Committee</td>
<td>Social and Cultural (Dietary)</td>
<td></td>
<td><img src="http://www.halalmc.net/halal_certification/overview.html" alt="Halal Monitoring Committee Logo" /></td>
<td><a href="http://www.halalmc.net/halal_certification/overview.html">http://www.halalmc.net/halal_certification/overview.html</a></td>
</tr>
<tr>
<td>Certification Scheme</td>
<td>Primary Aims</td>
<td>Secondary Aims</td>
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<td>Source of Signal</td>
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<tr>
<td>------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
<td>---------------------</td>
<td>-------------------------------------------------</td>
</tr>
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<td><strong>RSPCA Freedom Food</strong></td>
<td>Animal Welfare (from birth to slaughter)</td>
<td>Origin</td>
<td><img src="image" alt="RSPCA Logo" /></td>
<td><a href="http://www.rspca.org.uk/freedomfood">http://www.rspca.org.uk/freedomfood</a></td>
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<tr>
<td><strong>Fairtrade</strong></td>
<td>Equitable Trade</td>
<td>Labour conditions</td>
<td><img src="image" alt="Fairtrade Logo" /></td>
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<td><strong>RainForest-Alliance</strong></td>
<td>Environment - Natural resource management</td>
<td>Equitable Trade</td>
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</tr>
<tr>
<td><strong>Traidcraft</strong></td>
<td>Equitable Trade</td>
<td>Environment (less with production but more about seeking to lessen impact of their work)</td>
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