Sustainability Assessment Framework for Food Supply Chain Logistics: Empirical Findings from Dutch Food Industry

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Abstract

Food companies are increasingly challenged to balance business performance and economic gains with environmental and social performance. Therefore, in 2012, we started a collaborative project on this topic named SCALE (*Step Change in Agri-food Logistics Ecosystems)*. SCALE aims to improve the sustainability of food and drink supply chain logistics in the context of rising food demands, increasing energy prices and the need to reduce environmentally damaging emissions. More in particular, SCALE aims to deliver a number of tools and frameworks valuable for the agri-food sector to secure a step change in operational practices, which will improve the efficiency and sustainability of supply chain logistics. In the paper we will present first results of this project. Aim of this paper is (1) to present a sustainability research framework for food supply chains logistics including drivers, strategies, performance indicators, metrics and improvement opportunities to measure and potentially enhance sustainability performances; and (2) to analyse and diagnose the current status of Dutch food & drinks companies and logistics service providers using this framework. Results are found via a literature review, web-based research and structured interviews with Dutch food industry and logistics service industry.

Keywords: *Food Logistics, sustainability, performance, food industry, logistics service providers*

1 Introduction

Population growth, alterations in our overall nutritional status and rising economic incomes have all contributed to a significant increase in global consumption of food (Tilman et al., 2002). This increased consumption has consequently increased the demand, production and distribution of food worldwide thus leading to severe global economic, social and environmental problems in the world as well (Tilman et al., 2002). Food sectors require increased production while simultaneously demanding a decrease in the negative impact of this production (FAO, 2012). In this context, sustainability has emerged as an essential agenda for our entire society. As noted by Baldwin, “Sustainable development has been defined as meeting the needs of the present without compromising the ability of future generations to meet their needs” (Baldwin, 2009, p. Xiii). Food companies are increasingly challenged to balance business performance and economic gains with environmental and social issues.

To help decision-makers select from among various sustainable improvement steps, a comprehensive assessment regarding the *triple bottom-line* performance is needed. This Triple Bottom Line concept (TBL) concept was first used by Elkington (1998) and is explained as: “simultaneously considering and balancing economic, environmental and social goals from a business point of view.” Craig et al. (2008) state that TBL suggests that at the intersection of social, environmental, and economic performance, there are activities that organizations can engage in which not only positively affect the natural environment and society, but which also result in long-term economic benefits and competitive advantage for

the firm. This engagement of activities is called *sustainable supply chain management* (SSCM). To elaborate, "SSCM is the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key interorganizational business processes for improving the long-term economic performance of the individual company and its supply chains (Craig et al., 2008)". A TBL assessment makes it possible to select (and design) food production chains that can reduce environmental degradation, economic instability and social insecurity. This not only refers to all forward processes in the chain, but also to the reverse processes to collect and process returned products in order to ensure socio-economically and ecologically sustainable recovery (Bloemhof and van Nunen, 2008).

According to FAO (2012) more than 100 countries have established national strategies for sustainable development, including sustainability targets and indicators. In spite of the abundant attempts for making food and agriculture sectors sustainable, no internationally accepted standard defines what 'sustainable food production' essentially requires. "Neither a commonly accepted set of indicators that have to be taken into account when measuring sustainability performance, nor widely accepted definitions of the minimum requirements that would allow a company to qualify as 'sustainable', exist" (FAO, 2012, p. 9). This is supported by Hassini et al. (2012) who conducted an extended literature review of 707 papers on sustainability performance metrics of the last decade (2000-2010) and identified, amongst others, the following challenges:

- There are many environmental indicators, but which to use, when and how?
- Some environmental measures are linked to clear governmental regulations, many economic and social measures are not and it is usually hard to enforce compliance throughout the supply chain.
- Different (types of) SC players with, potentially conflicting, strategies have to agree on which metrics to use, with which data and deal with confidentiality issues.
- Due to the dynamic nature of supply chains, required measures change in time. Furthermore, companies might have different roles in different chains requiring management on different performance indicators at the same time.

The aforementioned gaps necessitate the definition of a state of the art framework for sustainability supply chain assessment.

In 2012, we started a collaborative international project on this topic named SCALE (*Step Change in Agri-food Logistics Ecosystems)*. SCALE aims to improve the sustainability of food and drink supply chain logistics in the context of rising food demands, increasing energy prices and the need to reduce environmentally damaging emissions. More in particular, SCALE aims to deliver a number of tools and frameworks valuable for the agri-food sector to secure a step change in operational practices, which will improve the efficiency and sustainability of supply chain logistics. This paper contributes to the SCALE-project, because it aims to develop a sustainability framework to measure and potentially enhance sustainability performances of food supply chain logistics. In the paper we will present first results of this project. Aim of this paper is (1) to present a sustainability research framework for food supply chains logistics including drivers, strategies, performance indicators, metrics and improvement opportunities to measure and potentially enhance sustainability performances; and (2) to analyse and diagnose the current status of Dutch food & drinks companies and logistics service providers using this framework. Results are found via a literature review, web-based research and structured interviews with Dutch food industry and logistics service industry.

The remainder of this paper is as follows. Section 2 introduces our sustainability assessment framework, specifically for food supply chain logistics, to propose a structured and rational method for assessing sustainability. Next, Section 3 and 4 describe findings from practice where we specify the elements of the sustainability assessment framework, based upon explorative web-based research and structured interviews with best practice players in the field respectively, resulting in an overview of barriers for sustainability improvement. We end this paper with conclusions and further research opportunities.

2 Sustainability assessment framework for food supply chain logistics

Literature suggests several strategic, tactical, and operational redesign strategies to improve the efficiency and effectiveness of food supply chain processes (Van der Vorst and Beulens, 2002). Up to recently, this related foremost to the improvement of process efficiency (hence minimisation of costs) and customer service levels. Now, the TBL concept evokes the need for an integrated approach that links supply chain design decisions to all three pillars (economic, environmental and social pillars) of sustainability (Chaabane et al., 2012). This is supported by the literature review of Tang and Zhou (2012), who indicate that there is a need to fill the gap between practice en theory; i.e. to integrate sustainability issues with traditional performance indicators as costs, responsiveness and product quality. Or as Van der Vorst et a. (2009) state, investments in food supply chain design should not only be aimed at improving logistics performance, but also at the preservation of food quality and environmental sustainability.
Figure 1 presents an overview of our sustainability assessment framework for food chain logistics; a framework that can be used to redesign the supply chain resulting in improved overall performance. Each of the elements and, successively, the steps of the framework will now briefly be presented. In the follow up sections of this paper we will discuss the findings on each of the elements and steps in practice.

Core elements of the framework

The framework departs with (see the center of the figure) the definition of the supply chain under study, including the chain strategy on sustainability, related performance indicators and drivers for sustainability. It is obvious that different organizations strive for different goals, hence formulate different strategies. And the degree of sustainability involvement and the choice for certain sustainability initiatives and improvement opportunities depend on the strategy of a company. Hagelaar et al. (2002) present three different sustainability strategies, namely;

- *Compliance-oriented strategy*: aimed at compliance with rules and regulation; focus on end-of-pipe techniques to reduce negative output.
- *Process-oriented strategy*: a more pro-active approach based on the internal driver of pollution prevention pays (a better return) under the condition of compliance with rules and regulation. Focus is on reduction of the use of raw materials and prevention of waste within the separate steps in the production process.
- *Market-oriented strategy*: a pro-active approach to brand sustainable performance to reach competitive advantage. Focus is on total reduction of the environmental burden caused by the design of the product, next to an optimal social and financial performance.

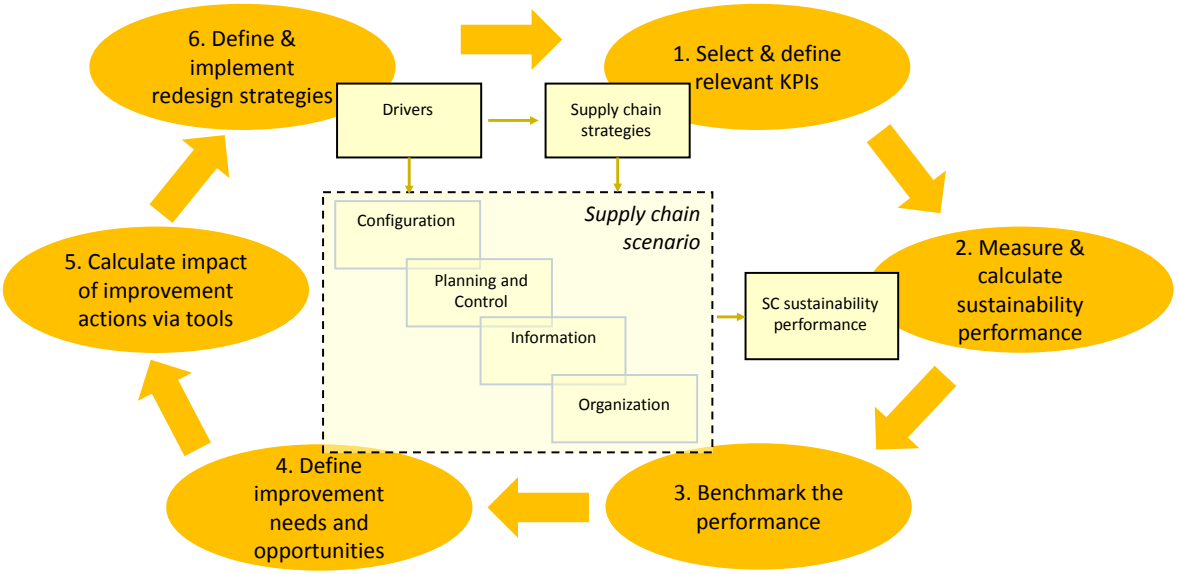

Figure 1. Sustainability assessment framework for food supply chain logistics.

The choice of the sustainability strategy is influenced by drivers. Lee and Klassen (2008) state that a driver is a factor that initiates and motivates firms to adopt (in this case) SSCM. There are internal drivers, i.e. drivers within a company that help to achieve sustainable practices, and external drivers, i.e. factors beyond the company's boundaries and capabilities. It is clear that different strategies will result in different supply chain designs, or scenarios. In detail, a supply chain scenario can be described by four elements (van der Vorst and Beulens, 2002; Vlajic et al., 2012):

- *chain configuration*: the structure, facilities and means, the parties involved and the roles to be performed in the supply chain;
- *chain control structure*: the set of decision functions (located at multiple decision layers with different decision horizons) that govern the execution of operational activities aimed at realizing logistical objectives within the constraints set by the chain configuration and strategic objectives (e.g., delivery frequency, order acceptance policy, production planning structure, etc.);
- *chain information systems*: the systems (with their characteristics) that support decision making (enable information exchange and make data available) and/or are required to perform operations (e.g., EDI, ERP, APS, TMS, WMS, etc.);
- *chain organization and governance structures*, which assign tasks (along with the corresponding responsibilities and authorities) to organizations and persons in the supply chain.

Depending on the sustainability strategy chosen, specific sustainable transportation means or warehouses will be (or will not be) selected, planning systems will include sustainable criteria, information systems will gather and exchange sustainability data, and, dedicated sustainability departments will be established.

Steps of the framework

Our structured sustainability assessment framework comprises six steps, starting with the selection and definition of the relevant sustainability Key Performance Indicators– of course depending on the chosen strategy (step 1). KPIs can be used to measure whether targets

have been realised in practice; KPIs refer to a relatively small number of critical dimensions which contribute more than proportionally to the success or failure in the marketplace (Gunasekaran and Kobu, 2007). A well-defined set of supply chain KPIs will help establish benchmarks and assess changes over time. This is done respectively in step 2 (where the current performance is measured) and step 3 (where the performance is benchmarked). The benchmark results in improvement needs, which can be aligned to available improvement options. These are defined in step 4 and assessed in step 5 using sophisticated modeling tools. According to Dekker et al. (2012) improvement options in sustainable logistics focus particularly on inventory, transportation and facility decisions. Note that Seuring (2012), based on an extended literature review on sustainability modeling approaches, states that it is important to develop alternative modelling approaches that support multi-dimensional trade-off calculations and identify win-win solutions. Finally, redesign strategies can be defined that – after implementation – improve the sustainability performance on the chosen indicators (step 6). After such an assessment, redesigns can be proposed, piloted and finaly implemented if they turn out to be a succesfull business case. To emphasize, this conceptual sustainability framework provides a closed loop architecture for a constant evaluation and improvement opportunities identification for food logistics sustainability.

Application of the framework

In the remainder of this paper, we aim to get insight in some of the core elements and steps of Dutch food industry using an explorative research strategy. More in particular, we will present results on drivers, strategies, KPIs that companies use, improvement opportunities that have main attention in industry and, finally, barriers companies experience in sustainability improvement. This assessment should be seen as a first analysis as only a limited number of companies are investigated. In the SCALE project more extended research will take place, finally resulting in three pilots in which improvement options will be implemented and tested.

3 Web-based desk research results

This section describes findings from practice where we specified elements of the sustainability assessment framework, based upon explorative web-based research. 17 Food industry companies were selected for the web-based research on the food industry from the top 25 (highest turnover) Dutch food/drinks companies present in the Food Top 100 (Nyenrode Business University, 2012). Data is obtained by a visit to the corporate website and reading the company's sustainability report; 11 companies present a sustainability report. Information is obtained by using the following search terms; sustainable, sustainability ("duurzaamheid" in dutch), responsible, , CSR ("MVO" in dutch) on the corporate website. Furthermore, 19 logistics service providers (LSPs) were selected for the web-based research, all operating in the Dutch food and drinks supply chain. They are present in the TOP 50 of logistics service providers in 2012 provided by the magazine 'Logistiek' (www.logistiek.nl). Data on the LSPs is collected using the same search strategy and terms as for the food industry. Here six LSPs provide a sustainability report.
Table 2 presents an overview of sustainability KPIs mentioned most in sustainability reports by Dutch food or drinks companies and LSPs, the number of companies that use these indicators and which sustainability dimension the indicators address. Results show that the planet dimension has most attention of industry, next to people indicators. Energy and

water use as well as emissions have most attention from food industry; carbon footprints are central to LSPs. Interestingly, the profit dimension is hardly mentioned by all parties. Apparently this is not seen as a unit of sustainability! It is clear that sustainability in the 3BL sense has more attention from food industry.

Table 2. Overview of key sustainability indicators of food and drinks companies

Food Industry			*Logistic Service Provider*		
Indicators	*# /17*	*3BL*	*Indicators*	*# /19*	*3BL*
Water use (m3)	11	Planet	CO2 emissions transport	5	Planet
Energy use	10	Planet	Fuel use	3	Planet
CO2 emissions (tonnes)	9	Planet	CO2 emissions facilities	3	Planet
Male-female ratio (% of total fte)	8	People	Trained employees (%)	3	People
Total waste production	7	Planet	Absenteeism (%)	3	People
Accidents (Freq. rate)	7	People	Absenteeism (total days)	3	People
Renewable energy (%)	6	Planet			
Recycling & recovery rate	6	Planet			
Absence (%)	6	People			
Trained employees (hours/fte)	5	People			

Furthermore, after a thorough search on the internet, we selected and analysed four sustainability certificates used in the Netherlands to assess the indicators and improvement options they aim for; the *Lean and Green programme*, the *CO_2 performance ladder*, the *European certificate Green Freight Europe* and the *Green Care Transport*. All certificates focus especially on CO_2 emision reductions in road transport, but also attention is given to reduction of waste and costs (due to sustainability improvements). Whereas the Lean and Green award focuses purely on logistics, the CO_2 performance ladder focuses on all industries and tries to integrate the companies' suppliers as well. Green Freight Europe focuses on road transportation within Europe, whereas Green Care Transport has a global focus. All certificates provide an award or certification when a company participates in their initiative.

In the Netherlands the Lean and Green Award has had major attention in the Netherlands. Over 250 'front running' companies initiated concrete plans with measurable objectives to reduce their CO_2 emissions amount with 20% within five years. Table 3 provides an overview of the 280 improvement opportunities for reducing CO_2 emissions in logistics mentioned by the participants and classified to the four elements of the supply chain scenario. Most improvement opportunities (about 60%) mentioned by companies refer to the configuration level; 25% refers to planning and control, 10% to information system improvements and 5% to changes in the organisation. Of course this only refers to the frequency and not to the importance of each improvement opportunity (in specific cases)! The improvement opportunities at configuration level are mainly characterised as internally optimizing, whereas for planning and control and information systems most options require supply chain collaboration. It shows that companies start with improving their own business first, before moving on to the supply chain. Collaboration between supply chains and its facilities are considered most as future options to further improve sustainability.

Table 3. Sustainability improvement options (*italic* = requires partner involvement)

Configuration (60%)	Planning & Control (25%)	Information (10%)	Organisation (5%)
Green warehouse New truck, LZV Vehicle adjustments Fuel adjustments Relocation sites New production equipment *Network redsign* *Packaging redesign* *Multi-modal network* *New supplier*	Less material use *Delivery adjustments* *Planning adjustments* *Supply adjustments* *Consolidation* *Collaboration* *Joint planning* *Client involvement*	Fleet management systems (new) TMS (new) WMS *Info sharing with clients*	Create internal awareness Change organisation structure (QSHE) *Create external awareness*

4 Interview results

This section describes findings from practice where we specify elements of the sustainability assessment framework, based upon six structured interviews with best practice players in the field. We interviewed three multinational food companies of different subsectors; one in the soups & sauces sector (food company FC1), one in the meat sector (food company FC2) and one company in the fast moving consumer goods sector (food company FC3). Two of these companies are also present in the top 25 list of food companies refered to earlier. To safeguard anonymity, the companies are not mentioned by name. In the logistics service industry, we interviewed three logistics service providers (LSP) of the Top 50 list; two multinationals (LSP1 and LSP2) and one national player (LSP3). The persons interviewed are logistics or sustainability managers. They were initially contacted by e-mail or phone to ask for a face-to-face interview. Two interviews are held by phone (with FC2 and LSP3), because time of the managers was limited. The interviews took approximately one hour and were recorded with audio-device and transcripted to make sure no information was missed. For each partner the steps of the sustainability assessment framework were discussed. First, the drivers and sustainability objectives were idenfied. Then successively, the relevant performance indicators and measurement methods, the sustainability improvement opportunities, and the barriers they experience were inventorised. We will discuss the main findings now.

Drivers for sustainable strategies

The internal and external drivers identified by a literature study were tested during the interviews. Table 4 presents an overview of the drivers mentioned by the respondents. The food industry and logistics service industry are positioned next to each other to show similarities and differences in internal and external drivers for sustainability.

Table 4. Drivers for sustainability mentioned by the companies

Internal drivers	FC 1	FC 2	FC 3	LSP 1	LSP 2	LSP 3
Cost-savings	x	x	x	x	x	X
Reputation / branding		x	x		x	X
Positive effect on environment	x	x	x		x	
Continuation of company; 3P- vision	x	x	x			
It is in the genes of the company	x		x		x	

Enthusiastic top-management	x		x				
Efficiency improvement		x	x				
To improve employee situation		x				X	
Opportunities because of science and technology	x				x		
Responsibility as pollutant				x		x	
Cost benefit for clients						x	
Internal reputation to employees							x
External drivers							
Market dependance	x	x	x				
Client dependance				x	x	X	
Opportunities in current policy and regulations		x	x	x		X	
Stakeholders influence		x	x				

Almost all drivers were identified by one or multiple respondents; only flexibility increase – indicated in literature as a sustainability drive - is not explicitly mentioned. Interestingly, most emphasis is given to internal drivers. All food companies emphasise continuation of the company, cost-savings, and positive effect on the environment. FC1 and FC3 also share two other internal drivers; enthusiastic top management and “it is in the genes of the company”. FC2 and FC3 also share efficiency improvement and reputation. The food companies have one corresponding external driver; market dependence. This is a combination of consumer wishes, and actions of competitors. However, FC1 and FC3 acknowledge market dependence but state that pressure from clients is not a driver for sustainability. The LSPs have one corresponding internal driver; cost-savings. As LSP1 states “Our driver is of course energy savings, and thus cost-savings.” LSP2 and LSP3 both state that they have the intrinsic value of being responsible for their actions. Reputation is also a shared internal driver. LSP3 states “It’s a combination of client demand, ….. and social responsibility.” The LSPs also have one corresponding external driver; client dependency. Moreover, LSP1 states that when a client does not prefer sustainability, sustainable services will not be executed. LSP3 states that “environment and sustainability is a factor that is considered more and more in tenders”.

Sustainability strategy

Regarding objectives the focus is foremost on process improvement; during the interviews it was often said that sustainability can only be realised when it is economically efficient, since this continues the existence of a company. One respondent even states that improvement of sustainability is never the core business of a profit organisation, making profit is. Some of the best practice companies focus on reputation/branding; both industries acknowledge that acting sustainable increases a positive reputation as it shows to their stakeholders that they are concerned with the environment. Overall, LSPs do have a wait-and-see attitude towards sustainability. In contrast, food companies state that they want to make steps, especially because the market demands more sustainable products.

Barriers for sustainability improvement

The barriers perceived in sustainability are mostly caused by the characteristics of the industry. It is stated that the logistics service industry is less dynamic, independent and changeable and therefore less involved in sustainability. Collaboration with each other is the

most important improvement opportunity perceived. However, collaboration with competitors by bundling flows is perceived with reluctance by the logistics service industry. They perceive barriers in problems with cost divisions and social-cultural issues like trust. Moreover, collaboration between LSPs is perceived as cartel forming by other, non-collaborative LSPs. Other barriers mentioned are presented in Table 5; note that external barriers go beyond a company's own capabilities. The food companies provided twelve barriers. An important one is the fact that legislation and social pressure are not equal in different countries; and that local infrastructures are also different in different countries.
Also specific barriers on performance measurement were mentioned. This related foremost to the difficulty to measure social sustainability, difficulty to standardize due to different approaches of countries, difficulty to measure the results of sustainability initiatives and that there are too many different measurement methods. As a food company stated: "Every LSP has its own measurement method in excel. This counteracts benchmarking and universal measurement." The fact that a universal measurement system is lacking and necessary to measure sustainability is not shared by all respondents. The interview results show that front runners in the food industry want to benchmark, whilst followers are less enthusiastic about a measurement system. In findings on the logistics industry this is the other way around. The front runner experiences a lot of complexity, whilst the follower desires a universal system since it could help them to measure sustainability. Thus, thoughts about a universal measurement system are diverse and assumed to be company-specific.

Table 5. Mentioned barriers for sustainability improvement

Type	*Barrier*	*Company*
Internal	Requirements as a stock-listed company	FC1
	Economic focus jeopardised by sust. focus	FC2, LSP1
	Lack of information sharing	FC3
	Awareness of employees is lacking	LSP1,LSP2
	Internal political barriers	LSP1
	Characteristics of company	FC1, LSP2
	Reporting at wrong deparments	LSP2
	Sub-contracting to LSPs	LSP2
	Social-cultural aspects in collaboration	LSP3
External	Differences within Europe and globally	FC1,FC2,FC3,LSP2
	Dependency of client demand/market	FC1, LSP2, LSP3
	EU policy	FC1
	Government has slower way doing business	FC3, LSP3
	2/3 sustainability issues at the consumers	FC3
	Economic crisis	LSP1,LSP2
	European rail network does not connect	LSP1
	Multiple initiatives in different countries	LSP1
	No insight in long-term cost benefits	LSP1
	Cost division in joint networks	LSP2
	Contract term with client	LSP2
	Characteristics of industry	LSP2
	Collaboration seen as cartel forming	LSP2
	The will and necessity of collaboration	FC1, LSP3
	Collaboration enforces transparancy	LSP3

5 Discussion and conclusions

The results of the desk research are strengthened by the results of the interviews. The low focus on the profit dimension was explained by the fact that companies do not relate profit directly to sustainability performance measurement, since profit whether or not related to sustainability, is always measured as stated by FC3. The top ten indicators of the food industry identified during the web-based research highly correspond to the indicators mentioned during the FC interviews. However, two indicators; renewable energy and absence of employees were not identified. The top six indicators of the logistics service industry identified during the web-based research also highly correspond to the indicators mentioned during the interviews. One indicator, absenteeism, was not mentioned by any LSP respondent.

The research shows that both industries have a different attitude towards sustainability. LSPs have the wait-and-see attitude. For example, LSP1 states that big investments for sustainability will only be made when all clients demand sustainability and that this is currently not the case. They state that sustainability can also come with smaller, less expensive steps. This explains the low level of external and innovation-oriented sustainability initiatives of LSPs. In contrast, food companies state that they want to make steps, especially because the market demands more sustainable products.

In both industries current short-term contracts is experienced as a barrier that counteracts opportunities in sustainability. It is stated that short-term contracts limit food companies and LSPs' resources for sustainability investments, due to the uncertainty the short-term contracts bring to especially the logistics service industry. Long-term contracts – hence more intense collaboration in the supply chain - are seen as an opportunity since it can create more investments possibilities and 'freedom' for logistics service providers. FC3 already operates with long-term contracts which according to them make chain-wide sustainability more realisable.

Most improvement opportunities that intervieuwees mention are internal (configuration and planning and control) improvement options; especially the creation of a positive attitude towards sustainability gets attention. The interviews showed that the mind-set within employees of LSps is not yet focused on sustainability, whilst the mind-set of employees of food companies is.

To conclude we an integrated framework for 3BL indicators covering the economic, environmental and social aspects of food chains along the entire life of the products with emphasis on food logistics. This framework and the subsequent applied methods for evaluation are intended to propose a structured and rational method for assessing the sustainability. Since this research is an explorative and qualitative research with only a limited number of interviews, it means that no statistical or generalisable statements can be made. The preliminary findings provide clear indications for further research, in which the SCALE project aims to contribute.

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