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Usefulness of lean as a sustainable strategy in food supply chains

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Double degree master's thesis · 30 hec · Advanced level
Agricultural Programme – Economics and Management
Degree thesis No 897 · ISSN 1401-4084
Uppsala 2014

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Credits: 30 hec

Level: A2E

Course title: Independent Project/Degree Project in Business Administration

Course code: EX0536

Programme/Education: Agricultural Programme – Economics and Management

Faculty: Faculty of Natural Resources and Agricultural Sciences

Place of publication: Uppsala

Year of publication: 2014

Name of Series: Degree project/SLU, Department of Economics

No: 897

ISSN 1401-4084

Online publication: <http://stud.epsilon.slu.se>

Key words: food supply chains, lean practices, sustainable development, triple bottom line



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USEFULNESS OF LEAN AS A SUSTAINABLE STRATEGY
IN FOOD SUPPLY CHAINS

SCHOOL OF APPLIED SCIENCES
Environmental Management for Business

MSc THESIS
Academic Year 2013-2014

Supervisors: Jason Weeks and Cecilia Mark-Herbert
September 2014

Acknowledgements

I would like to say special thanks to my two supervisors Prof. Jason Weeks from Cranfield University and Prof. Cecilia Mark-Herbert from Swedish University of Agricultural Sciences, for giving me excellent support throughout my thesis. Jason especially helped me by pushing me to believe in myself and trust my own ideas, and by being available to meet and discuss my issues when I needed it. Cecilia especially helped me by encourage me to aim for high standards as well as giving comprehensive and fast feedback whenever I asked for it.

Further, I would like to thank Dr. Denyse Julien from Cranfield University for taking time to meet and talk about my thesis and share her knowledge in the area.

Lastly, I would like to thank my friends and colleagues Francesca Gavassini, Siri Lindqvist Ståhle, Alexa Blanc and Anton Salduskin for proof reading and commenting on my thesis.

Abstract

Global food supply chains need to become more efficient in terms of decreasing resource use and minimising food waste. With this objective some food enterprises in UK have started to adopt 'lean thinking'. Little academic evidence exists on whether or not this is a sustainable strategy. Sustainability can be defined through the 'triple bottom line' including economic, environmental and social aspects. A literature review was conducted to explore the applicability of lean thinking as a sustainable strategy in food supply chains. It showed that lean has potentials, but would require trade-offs where lean principles are adapted to the characteristics of food supply chains and where it also includes environmental and social aspects to a greater extent. Collaboration and shared benefits between all participants is necessary for the success of lean. This is currently the issue in existing food supply chains in the UK.

Abbreviations

CSR: Corporate Social Responsibility

Defra: Department for Environment, Food and Rural Affairs (UK)

FAO: Food and Agriculture Organisation of the United Nations

TBL: Triple Bottom Line

UN: United Nations

VSM: Value Stream Mapping

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ARTICLE INFO

Keywords

Food supply chains
Lean practices
Triple bottom line
Sustainable development

ABSTRACT

Global food supply chains need to become more efficient in terms of decreasing resource use and minimising food waste. With this objective some food enterprises in UK have started to adopt 'lean thinking'. Little academic evidence exists on whether or not this is a sustainable strategy. Sustainability can be defined through the 'triple bottom line' including economic, environmental and social aspects. A literature review was conducted to explore the applicability of lean thinking as a sustainable strategy in food supply chains. It showed that lean has potentials, but would require trade-offs where lean principles are adapted to the characteristics of food supply chains and where it also includes environmental and social aspects to a greater extent. Collaboration and shared benefits between all participants is necessary for the success of lean. This is currently the issue in existing food supply chains in the UK.

1. Introduction

The global population is growing rapidly. Multiple estimations suggest that it will reach 9 billion by 2050 (UN, 2013; Defra, 2010; FAO, 2009). There are many issues related to this development but one important problem is how to feed this growing population, and more essentially, how to feed it in a sustainable way. Food and Agriculture Organisation (FAO) (2009, pp.2) states that food production needs to be increased by 70 percent by 2050 compared to 2005-07 levels in order to meet the future demand. Although, approximately one third of all food produced globally each year becomes food waste (Tscharntke *et al.*, 2012, pp. 55). This is an opportunity for improvement within the food industry since it is a cost for both the planet and the overall economy when resources are not managed efficiently. Having said that, current food supply chains need to focus on becoming more resource efficient and minimising their waste.

The concept of 'lean thinking' is a way of managing resources in order to increase customer value and has emerged from being a strategy in mass-producing vehicle industries into other sectors and smaller enterprises (Womack and Jones, 2003). Its benefits lie in continuously improving main stream business operations to minimise all kinds of waste.

Although minimising waste is a good starting point in sustainable development, it is not enough to become fully sustainable. Elkington (1999) states that sustainability occurs when economic, environmental and social aspects are all taken into account equally.

According to a survey from Accenture (2010, pp. 10) 93 percent of the world CEOs acknowledges that their company's future success will be determined by sustainability. The European Commission (2010) also emphasises the importance of sustainability in the retail sector to secure food availability for consumers.

There are retailers within the UK agri-food sector that have adopted lean thinking at a business level (Jain and Lyons, 2009; Zokaei and Simons, 2006) and others at a supply chain level (Lee *et al.*, 2013; Zokaei and Simons, 2006). However, there is little academic research about lean in agri-food supply chains and how well it performs in that context (Ugochukwu *et al.*, 2012).

1.1. Lean thinking

Lean thinking consists of several tools and principles but this thesis only acknowledges 'the five principles', due to its usefulness both within and beyond the firm, such as in a supply chain context (Womack and Jones, 2003).

1. Value
2. The value stream
3. Flow
4. Pull
5. Perfection

According to lean thinking, **value** implies what consumers perceive as value and not what processes are needed to produce the product or service (Womack and Jones, 2003).

The value stream includes all processes a product requires for its creation (Womack and Jones, 2003). *Value Stream Mapping (VSM)* visualises the processes and can help track waste (Womack and Jones, 2003; Folinas *et al.*, 2013). There are three types of processes: 1) those that solely generate value, 2) those which do not generate value but that cannot be eliminated in the current situation and 3) those that do not generate value and are possible to eliminate (Womack and Jones, 2003, pp.20). It can be argued that the latter already should have been found and eliminated within a business, but the value goes beyond the business to a whole system. Therefore waste may be unknown due to bad knowledge about previous and later participants of the chain and their operations, which is why a broader picture is needed to track down all waste (Womack and Jones, 2003).

When the value is defined and the value stream is found and optimised, the next step is making sure the remaining steps **flow**. For instance make sure there are no delays, and to avoid batch production (Womack and Jones, 2003). Integrating a supply chain and making participants work together can also create flow (Jain and Lyons, 2009). Lean thinking further includes that there should be a **pull** demand from consumers, rather than push from manufacturers, for instance right quality, to a certain price and at a certain time (Womack and Jones, 2003). These first four principles are interlinked with one another in a circular process. When one of them improves it can drive the others to improve as well. It is supposed to be a constant strive towards **perfection**. Transparency is a part of perfection. The more all participants in the value chain knows about each other, the easier it will be for them to track down and eliminate waste and hence create more value to the consumer (Womack and Jones, 2003). Short supply chains with few participants are better for collaboration than long supply chains (Ugochukwu *et al.*, 2012).

1.2. Characteristics of food supply chains

In order to understand how 'lean thinking' works in an agri-food context one must know the characteristics of food supply chains. Firstly they have heterogeneous products with variable perishability, uneven and/or long production lead times and uneven customer demand in terms of frequency and volume (Dora *et al.*, 2014; Taylor, 2005). This means that flexibility is limited and supply is uncertain. Moreover, the industry as a whole is characterised with highly variable quality and volume on raw material that is dependent on season. Moreover, since most food products have a short shelf life, the frequency of purchases is high and variable, even on a weekly basis (Jain and

Lyons, 2009). Lean works most efficiently in environments with high volumes and a demand that is stable and predictable (Cox and Chicksand, 2005).

There is a magnitude of food supply chains in the world and they are all different, with altered level of complexity. Smith (2008) mentions that local supply chains are often more sustainable than international food supply chains, since they are shorter and thus create less transport emissions and less externality. Mollenkopf *et al.* (2010) states the same and explains that it has been more difficult to implement lean practices in supply chains due to their increasing complexity and length. Complexity may contribute to a lack of visibility and also a smaller understanding of costs (CIMA, 2009).

1.3. *The triple bottom line*

The term *sustainability* is widely used although its full content is not always well understood. Many companies believe that *sustainability* and *sustainable development* is simply achieved by 'greening' their corporation through increasing efficiency and cutting costs (Elkington, 1999; Carter and Rogers, 2008; Seuring and Müller, 2008). But, according to Elkington (1999), sustainability is determined by the triple bottom line, including economic, social and environmental bottom lines that are all interlinked and equally important. This is the definition used in this study.

Economic sustainability includes factors as having competitive costs that will stay competitive, a current sufficient demand that is likely to stay, an innovation rate that is competitive in the long-run, a workforce or intellectual capital that will stay within the company and a sustainable profit margin (Elkington, 1999). **Environmental sustainability** includes what natural capital is used by the current business and how it is likely to evolve, if the natural capital used is sustainable and if the level of stress on nature is acceptable and will continue to be so (Elkington, 1999). **Social sustainability** includes aspects like *human capital* (skills, education and health) and on a broader level *social capital* (health of society and potential to create wealth). Sustainability of this bottom line is achieved when the human and social capital can be created, maintained and not lost over time (Elkington, 1999; Klassen and Vereecke, 2012). Trust within a company or enterprise is one important social aspect since "*widespread distrust in a society imposes a kind of tax on all forms of economic activity, a tax that high-trust societies do not have to pay*" (Elkington, 1999, pp.85).

These bottom lines are in constant movement depending on cycles, conflicts or pressure from politics, society, environment and economy. The focus of each of these is changing with trends in the system (Elkington, 1999). For instance the economic bottom line has traditionally been the main focus, but the social bottom line also emerged when human rights, a fair wage and no child labour became important for consumers. Currently the focus of the environment is increasing (Elkington, 1999). There has to be a long term balance between the three in order for it to be called sustainable (Yakovleva, 2007). For instance if the social bottom line is not maintained it can damage the other bottom lines, just as, if treated well it can increase their performance (Elkington, 1999; Pagell and Wu, 2009).

When considering 'lean' in the aspect of the 'triple bottom line' Pagell and Wu (2009) highlight that there is a difference in being *more* sustainable and *truly* sustainable. An organisation could implement a few of the lean practises and with that become more efficient and hence more sustainable. But it does not necessarily mean that by those incentives they are on a path of becoming truly sustainable; which is when all three bottom lines are in equilibrium (Pagell and Wu, 2009; Carter and Rogers, 2008).

Norman and MacDonald (2004) strongly critique the ‘triple bottom line’ approach in terms of measuring performance. They argue that the environmental and social bottom lines are so vaguely defined that it is easy for corporations to claim that they are sustainable, when they in fact are not. Carter and Rogers (2008) also found this problem. Since Elkington (1999) does not well define how to measure the performance of the TBL it is easy for corporations to report ‘good behaviour’ especially in the social aspect, since they can market the numbers in a way that looks good for the organisation, even though it is misleading. Elkington (1999) mentions that not everyone truly understands (or want to understand) the meaning of sustainability and thereby express that they are sustainable, when they are not. Womack and Jones (2003) mention a similar issue with lean. Some companies do short term competitive actions and cost cutting incentives to increase profit, such as minimising the amount of personal and by that putting pressure on remaining workforce, or using a dominant position in a supply chain to put price pressure on suppliers: *“they are usually eager to label these programs ‘lean’ although often they are only ‘mean’”* (Womack and Jones, 2003, pp.16).

Ultimately all theories have flaws. Norman and MacDonald (2004) make some fair points in their critique of the TBL-approach highlighting that Elkington did not provide enough specified description on how to measure the performance of the social bottom line. Although, despite this critique, the triple bottom line still creates a model for how to think about sustainability and what aspects to include, which is why it is being used in this thesis. Additionally, a large amount of literature considers the TBL, which is also an important point for this study.

In conclusion there is an empirical need to create more resource efficient and sustainable food supply systems. The area of interest in this thesis is where these three perspectives mentioned, intersect (Figure 1) and how they impact one another.

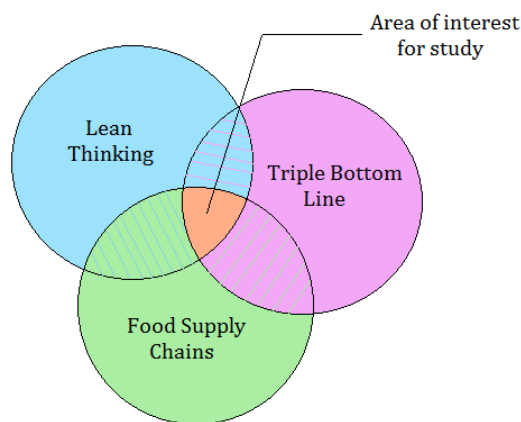


Figure 1. Intersect of ‘lean thinking’, ‘triple bottom line’ and ‘food supply chains’.

1.4. Aim of study

There are many studies focusing on combinations of sustainability, food supply chains and lean, but little research where all three are combined, hence the purpose of this paper is to explore this area. The findings (synergies and conflicts) are relevant for industry in the sense that it can help managers decide whether or not to implement lean (Mollenkopf *et al.*, 2010).

The **aim** of this paper is to explain challenges and perceived difficulties in implementing ‘lean’ management systems into food supply chains as a sustainable strategy. The **objectives** are to 1) discuss the combination of ‘the triple bottom line’, ‘lean thinking’ and ‘food supply chains’, from a small scale perspective and a large scale perspective and 2) to review academic literature and establish the current field of research in this area.

Research questions:

1. Which synergies and conflicts may arise when combining 'lean thinking', 'triple bottom line' and 'food supply chains'?
2. What are the communicated potentials of lean in food supply chains within the reviewed literature?

2. Research methods

This paper has a flexible design and an inductive research approach. A flexible design allows the researcher to be creative in conducting the study, instead of following a fixed predetermined structure (Robson, 2011). It is useful when dealing with qualitative data, which is the case of this study. Moreover an inductive approach implies theory building in contrast to a deductive approach which implies theory verification (Robson, 2011).

The theoretical starting point of this study is the combination of 'lean thinking', 'food supply chains' and the 'triple bottom line'. If these three areas can be combined without too much contradicting evidence, it would mean that implementing lean in food chains *is* a sustainable strategy. This grouping may be done in several ways however no specific guideline could be found in literature. Therefore one single option remained: to be creative within the boundaries of logic and surrounding theory.

Therefore this study explores the area of interest from two different perspectives. First through a participant perspective where challenges and opportunities that may arise for each participant in a food supply chain is explored (see 2.3). The second perspective is a systems perspective, which aims to give a broader understanding of the area from a large scale perspective (see 2.4). The combined perspectives will provide a comprehensive understanding of the topic.

2.1. Data collection and evaluation

The literature was collected using a traditional 'literature review' approach. A 'systematic literature review' was considered since it is a more rigorous and transparent process that provides firm and evidence based conclusions (Boland *et al.*, 2014). However the latter was not chosen, primarily because it has a fixed design and because it is more suitable when searching for quantitative data (Robson, 2011). Moreover, in some circumstances it may be time inefficient to go through literature in a fixed manner rather than flexible and thereby result in fewer articles found.

The keywords used in this review were initially: *sustainability of food supply chains, lean, green lean, supply chain management* and *food supply chains*. Further in the process other additional keywords became important such as: *consumers, retailers, processors/manufactures* and *primary production/ farmers*. Databases used were mostly: *Google, Google Scholar, Scopus, Web of Science, and Science Direct (Elsevier)*.

Both the keywords and key sentences were tried in multiple variations. It was a random and unstructured process, where the finding of one article automatically led to several other similar articles, either by recommendation from the search database or from the reference list within the articles. This method was proven to be efficient and it became clear that this topic area had a lot of data available.

The main criteria for selection of articles was that they in some way had to acknowledge either 'triple bottom line', 'lean thinking' or 'food supply chains', or combinations of them. The thesis had a set time frame, which limited the time available to search for and read articles. This was overcome by time management scheduling.

2.2. *Categorisation of literature*

Of all journal articles found during the thesis project the ones which appeared most relevant were categorised. The articles that qualified for categorisation had to *in depth* present sustainability in food supply chains or other supply chains, sustainability of lean thinking or just lean in food supply chains. The results from the process are visible in Table 1 below.

Seuring and Müller (2008) also conducted a categorisation of literature, assuming that all articles about the triple bottom line included the economic aspect. This assumption was not included in this thesis. If the economic bottom line was only briefly mentioned and the major arguments considered the other bottom lines, then that article was recognised as not looking at the economic bottom line. If this distinction had not been made, the categorisation would have been more homogenised and it would have been more difficult to draw conclusions from it. The weakness of this approach is that it is inevitably subjective and based on the author's interpretation of reviewed articles.

The oldest article in the categorisation is from 2001, since the scope of the search was to use only the most recent articles. This limited the use of out-dated material. The author assumed that the agri-food market and its operations are developing considerably over time due to fluctuating external factors (such as the financial market, changes in world trade and political environment). Therefore it was not deemed to be accurate to use old articles in describing the current situation. Further, the concept of the triple bottom line is also quite recent (Elkington, 1999).

A few conclusions could be drawn from the categorisation; for instance, the social bottom line was not as often highlighted in articles about sustainability compared to the economic and the environmental bottom line. Carter and Rogers (2008) and Seuring and Müller (2008) also concluded this. Klassen and Vereecke (2012) similarly state that the economic and environmental aspects recently have gained more focus than the social aspect in industry.

Further, there were few articles that included all three aspects of lean, food supply chains and sustainability. The articles had different approaches and focus, which may be seen as a weakness for the validity of the findings.

Table 1. Categorisation of reviewed literature.

Author (s)	Business within agri-food sector	General business within any sector	Food supply chains	Other supply chains	Economy	Environment	Social	Lean thinking	Key focus of article (sometimes best described by the "title")
King and Lenox (2001), Production and Operations Management		X		X	X	X		X	Relationship between lean and environmental performance in U.S. manufacturing facilities
Norman and MacDonald (2004), Business Ethics Quarterly		X			X		X		Critique of the triple bottom line accounting
Cox and Chicksand (2005), European Management Journal	X		X					X	Critique of lean management thinking in the UK red meat industry
Taylor (2005), Int. J. of Physical Distribution & Logistics Management	X		X		X			X	Improvement of UK agri-food chains through value chain analysis
Taylor (2006), Supply Chain Management: An International Journal	X		X					X	Strategic considerations when developing lean in the UK pork industry
Zokaei and Simons (2006), Int. Food and Agribusiness Management Review			X		X			X	Potential improvements in the UK red meat value chain when using lean production
Simons and Taylor (2007), Int. Journal of Production Economics			X					X	Combining lean thinking with food value chain analysis in the UK red meat industry
Yakovleva (2007), Journal of Environmental Policy & Planning	X		X		X	X	X		Measuring the sustainability in the UK of food supply chains (mainly chicken and potatoes)
Carter and Rogers (2008), Int. J. of Physical Distrib. & Logist. Managem.				X	X	X	X		Introduces sustainability to supply chain management thinking
Smith (2008), Philosophical Transaction of the Royal Society B	X		X		X	X	X		Different methods and opportunities to create more sustainable food supply chains
Seuring and Müller (2008), Journal of Cleaner Production		X		X	X	X	X		Literature review of sustainable supply chain management and the issues of it
Jain and Lyons (2009), Int. J. Services and Operations Management	X							X	"The implementation of lean manufacturing in the UK food and drink industry"
Pagell and Wu (2009), Journal of Supply Chain Management			X	X	X	X	X	X	A case study on what sustainable companies do different from 'normal' companies
Mollenkopf et al. (2010), Int. J. of Physical Distri. & Logist. Management			X	X		X		X	Combines three strategies: global supply chains, green and lean and their implementation
Vinodt et al. (2011), Clean Technologies and Env. Policy		X			X	X		X	Issues with sustainability when using lean manufacturing
Yang et al. (2011), Int. Journal of Production Economics		X			X	X		X	The relationship between lean manufacturing, env. management and business performance
Klassen and Vereecke (2012), Int. Journal of Production Economics				X			X		"Social issues in supply chains: Capabilities link responsibility, risk (opportunity), and performance"
Kogg and Mont (2012), Ecological Economics				X		X	X		Analyse practice of corporate social and environmental responsibility in supply chains
Styles et al. (2012a), Journal of Environmental Management	X	X	X	X		X			"Environmental improvement of product supply chains": best practice etc. for retailers
Styles et al. (2012b), Resources, Conservation and Recycling	X	X	X	X		X	X		"Environmental improvement of product supply chains: A review of European retailers' performance"
Ugochukwu et al. (2012), Management and Production Engineering Review				X				X	"Lean in supply chains": trends and issues within the field
Dora et al. (2013), Trends in Food Science & Technology	X							X	Application and performance of lean in small and medium sized enterprises (SMEs)
Dües et al. (2013), Journal of Cleaner Production			X	X	X	X		X	How lean practises can be used to improve environmental performance
Folinas et al. (2013), Procedia Technology 8			X		X	X		X	How value stream mapping (VSM) can be used to find waste and improve environmental performance
Hajmohammad et al. (2013), Journal of Cleaner Production				X		X		X	Lean management and its usefulness to improve environmental practices and performance
Total	9	7	13	12	13	15	9	16	

2.3. Exploring the participant perspective

A choice had to be made for the small scale participant perspective about whether to include all possible participants in a truly authentic food supply chain or to simplify a food supply chain and only mention the key value creating participants. The latter was chosen, because there is a magnitude of different food supply chains, and in this case it is more important to discuss about the topic in general rather than in detail, because if one specific product type was chosen, the findings would not be relevant for the agri-food industry as a whole. Additionally, the amount of literature available for a review would probably be limited. Furthermore, it is more feasible within the time frame of the project to keep it simple rather than complex.

Moreover, since the lean thinking is part of the study, a value chain approach is fitting. Accordingly, the following participants were chosen: *primary production, processing, retailer and consumer*. These are also most often highlighted in scientific research (Smith, 2008; Hingley, 2005, Hingley *et al.*, 2006; Yakovleva, 2007; Taylor, 2005).

These participants were all presented separately, to find barriers and opportunities to each when implementing lean practices and how that affects their overall sustainability. Figure 2 illustrates the process. By presenting each separately and then linking them in the end, provided a foundation to understand the topic. The unit of analysis through this process was the characteristics of the relationship between the four players since academic literature suggests it is a matter of relation and collaboration when lean is to be implemented in food supply chains (Vachon and Klassen, 2008; Smith, 2008).

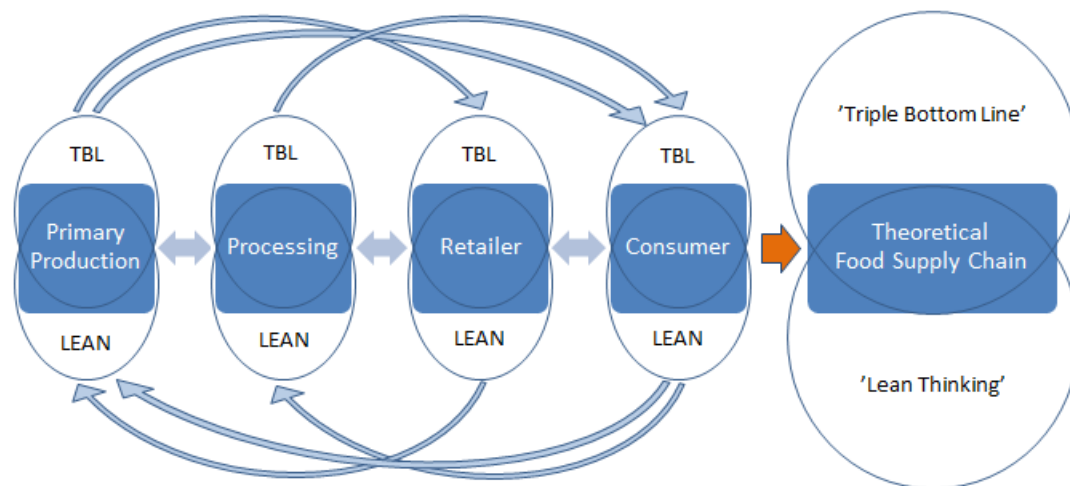


Figure 2. This is an illustration of the process of understanding how the four participants are interlinked and what relations they have with one another and how that affects the overall structure.

2.4. Exploring a systems perspective

Since there is a lack of literature that combines the area of interest in this study (Figure 1), the creation of a systems perspective was divided into two parts. The first part looked at literature regarding implementing lean in food supply chains (regardless of TBL). The unit of analysis in this case was relations concerning implementation. The second part looked at literature regarding lean in

any supply chain, with a strong focus on sustainability. The unit of analysis was therefore primarily TBL.

2.5. Delimitations

This study primarily focused on UK food supply chains and suppliers for simplicity and comparability. No primary data was included since the topic was too broad and it would require a comprehensive amount of interviews from different actors within the food supply chain (which was not deemed as possible within the duration of this project).

Further, implementation of lean is not discussed in great detail. It is kept general and applicable for any food supply chain as much as possible. Excluding detailed aspects of implementing lean is supported by Taylor (2005). He argues that the vision and organisational complications of implementing lean is more important to focus on, since the details are up to each supply chain to work with.

Further, there was a large focus on managerial aspects of lean since this is where the issues are most prominent. *Sustainability* in this thesis refers to the 'triple bottom line' (TBL). It is chosen since it is a well-established concept and frequently used in academia and in industry. 'Lean thinking' is explored due to a lack of evidence on its performance in the agri-food sector.

The main theoretical delimitation is that the analysis explores the potential of lean from a stakeholder perspective especially from the four key stakeholders in this study. The reason is that they are the main creators of value and probably the stakeholders that would be part of a collaboration agreement in practice.

2.6. Credibility of research

The findings of the paper are highly dependent on the assumptions made in the initial process. For instance the agri-food system is generally very complex and in this report strongly simplified. Therefore the findings may not be relevant to all types of food supply chains and it is likely that not all benefits and issues will be found. However, the work will provide a general understanding and a hint on how lean would work as a sustainable strategy in food supply chains.

The method of triangulation was used when possible to increase credibility of the findings. Triangulation means that data is collected from different sources to make sure it is trustworthy (Robson, 2011). Normally this means that beside journal articles, primary data is included from interviews or surveys etcetera. In this case triangulation was conducted through reviewing a number of academic articles to extract ideas and arguments that either support or oppose the idea of lean in food supply chains. One quality measure used was that if two articles had similar results, the author of this thesis made sure the information was not derived from the same source.

3. Results

In this section the idea of lean as a sustainable strategy in food supply chains is explored. It begins in small scale, with a participant perspective and continues to large scale, with a systems perspective.

3.1. Participant perspective of lean and sustainability in food supply chains

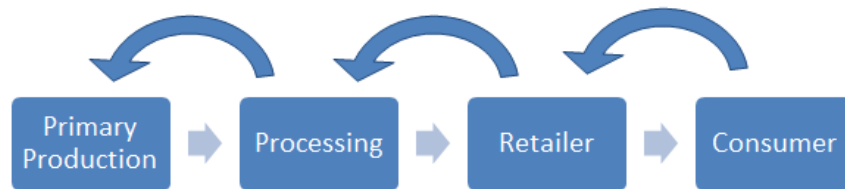


Figure 3. Here are the key participants in a general food supply chain and how the value flows between them.

Figure 3 illustrates the four participants of a general food supply chain. The consumer is the source of demand and the value is created in the three first stages of the supply chain. The following are descriptions of each participant in terms of general characteristics, lean thinking and TBL aspects.

3.1.1. Consumer

Kneafsey *et al.* (2013) conducted a study on the role of consumers in the development of sustainable food supply chains. It was found that consumers as a group may have power to push food supply chains into responsible production by purchase decisions, but as individuals they do not feel they have this power when buying. In some cases products that meet the customer value are not available in store, at the time of purchase, which means buyers cannot show their concern by purchasing the 'right' products. Therefore, consumers do not believe that it is their responsibility to drive sustainable change.

In terms of food security, consumers mention that affordability and availability, especially of healthy food, is of key importance for them (Kneafsey *et al.*, 2013). Food quality such as safe and nutritious food is of importance too. However, UK consumers do not have daily concerns about food security (Kneafsey *et al.*, 2013).

Sustainable aspects such as food miles, animal welfare and safety of food are typical features that are important to consumers (Yakovleva, 2007). There are certifications to ensure that these attributes are considered, however, few certification programmes include all aspects (Smith, 2008). Additionally, few consumers are actually willing to pay extra for such standards (Styles *et al.*, 2012b).

3.1.2. Retailer

Large companies are usually held responsible if a product is discovered to be unethically or non-environmentally produced by a supplier (Styles *et al.*, 2012a; Kogg and Mont, 2012). In this context retailers have a lot of pressure to perform well in terms of TBL, as well as keep consumers satisfied with their every-day requirements.

From a business perspective it may be assumed that one way of maximising consumer value, as well as maximising sales, is making sure the shelves in the shop are always full. This may be strategic, but not necessarily lean. For one, lean thinking encourages businesses to minimise levels of inventory, further it also strongly supports minimisation of waste, in this case food waste. However, larger quantities going through the system keeps prices down through economies of scale, which is

positive for consumers. Therefore, ultimately, retailers may need to choose between minimising waste and ensure there are enough products in stock to keep consumers satisfied (Dora *et al.*, 2014).

Retailers have become dominant players with the strongest buyer power in food supply chains in the UK (Hingley *et al.*, 2006; Yakovleva, 2007, Taylor, 2005). This position have been utilised through minimising purchase price from farmers and processors, which has created a culture of opposition and conflict towards retailers (Taylor, 2005). Even consumers have a tendency of not trusting retailers (Styles *et al.*, 2012b).

Retailers have a 'gate-keeper role' meaning they have the power to influence responsible actions of their suppliers (Smith, 2008; Styles *et al.*, 2012a). Styles *et al.* (2012b) emphasise the importance of retailers taking action and using their market power to initiate sustainable change in supply chains. This is a large undertaking since many products that the retailers purchase originate from long and complex supply chains. Retailers have diverse opinion about who has the responsibility to drive change. For example major grocery retailers tend to argue that sustainable development should be driven by consumer demand only, through what they purchase, while retailers in cooperatives tend to take that responsibility themselves (Styles *et al.*, 2012b).

Although, retailers may initiate activities to improve supply chain performance, they are still bound to keep low consumer prices which ultimately may lead to retailers forcing added cost for sustainability actions, onto their suppliers (Styles *et al.*, 2012b).

3.1.3. Processing

Processors generally work on a non-binding one-year 'supply agreement' basis towards retailers (Cox and Chicksand, 2005). Hence, the relation to retailers is not always certain nor necessarily long term. As described in Womack and Jones (2003), a lean production should be driven by a pull force from the consumers. However this becomes difficult for some food products, for example in the meat processing stage, where consumers may have a high demand on a certain part of an animal, which results in a 'carcass imbalance' since the remaining parts of the animal are not demanded to the same extent (Cox and Chicksand, 2005). This 'carcass imbalance' results in processors being dependent on supply agreement towards large retailers, since an agreement with them is the best way to optimise their operation (Cox and Chicksand, 2005).

Manufactured food has grown in popularity amongst consumers in the last years and processors currently aim to produce food products that are both convenient and healthy for consumers (Smith, 2008). These products are value creating for consumers. It is more difficult to add sustainable value to processed food products with multiple ingredients, since consumers cannot always see the sustainable accomplishments and these incentives then become unnecessarily expensive for processors (Smith, 2008). Further, these products may be derived from multiple sources, both local and international, which make information, traceability and flow difficult through the supply system (Smith, 2008).

Like the retailers, processors have a kind of 'gate-keeper role' and thereby have the ability to demand sustainability improvements of their suppliers (Smith, 2008; Styles *et al.*, 2012b). However, in comparison with retailers, the processors have limited power to do so (Taylor, 2006). In general, processors benefit from a stable supply from farmers (Smith, 2008). Further, closeness to suppliers is desirable as well as understanding of the suppliers' social and environmental risks.

3.1.4. Primary production

The profitability in the UK farming sector is currently weak (Taylor, 2006; Yakovleva, 2007). Price pressure from downstream customers reduces farmers' options to create profit. Additionally, farmers are usually never certain about future demand and price levels when planning their business (Cox and Chicksand, 2005). Their general option to increase profitability is to produce high volumes of produce to a good quality, with as low input as possible. Farmers also need to make sure to supply what is promised in their contracts. Weather is a factor that has a great impact on outcome and their ability to supply the volume and quality promised.

Farmers often sell their produce to the same customer year after year and consequently benefit more from a system that is stable and where they have power enough to be part of 'rules and regulation' planning of the partnerships (Smith, 2008). Their relationship with processors is therefore generally good (Taylor, 2005). Retailers can switch between domestic suppliers and suppliers from abroad. This weakens individual enterprises position and has created a culture of anger and lack of trust in supply chains towards retailers (Taylor, 2006).

In the supply chain as a whole, farmers have limited power and can therefore be enforced to implement costly sustainability standards by their buyers (Smith, 2008). Some farmers do not have the means required to do the changes demanded to get a contract as a supplier. Occasionally downstream participants want the whole supply chain to be sustainable and then help in different ways to do the necessary changes (Smith, 2008). Sustainable improvements at farm level have obstacles to overcome. For instance lean practices such as value stream analysing at farm level is not yet fully established and will require more research before it can be done according to best practice (Taylor, 2005). Further, small farmers do not write annual reports of their business, therefore it may be difficult to measure how farmers are performing in terms of sustainability and thereby problematic to improve (Yakovleva, 2007).

3.2. Systems perspective of lean and sustainability in food supply chains

Lean and sustainability in food supply chains are investigated here from a holistic systems perspective. First implementation issues and benefits of lean in food supply chains are explored followed by sustainability in food supply chains.

3.2.1. Lean in food supply chains

Lean can be divided into two levels: operational and strategic (Jain and Lyons, 2009). The value of consumers is included in the strategic level. The operational level is more bound to the floor of an industry. Most firms that implement lean focus mainly on the operational level. This is where waste elimination is highly prioritised whilst flow and alignment to demand is less so (Jain and Lyons, 2009). Jain and Lyons (2009) did a case study of implementing lean in food and drink plants in the UK and found that most plants used the principle "*elimination of waste*" (pp. 568). However, quick changeovers could not be used, since it is time consuming, and the rate of cleaning facilities was not possible to minimise, due to hygiene standards. The principle "*employee involvement and empowerment for continuous improvement*" (pp.568) was not used to a great extent in the plants since demand of food is shifting annually, meaning a large amount of the workforce is only temporarily employed in times of need. "*Aligning production with demand*" (pp.569) was found not to be used at all in the plants, due to uneven demand, fast perishability of food products, service and price on order, uneven yield and uneven product quality etcetera. The last principle "*supplier integration*" (pp.571) showed that price determines who gets the order, which results in a lack of

incentives to build long term partnerships with suppliers. Jain and Lyons (2009) stated as a conclusion that the lean model used in the automotive industry cannot solely be transferred to food and drink companies without alteration.

Lean thinking in both food companies and supply chains is a new and evolving process (Dora *et al.*, 2013). There has been critique on its applicability in food supply chains. Cox and Chicksand (2005) argue that lean principles can lead to non-existent or fallen profitability as well as a possibility of only powerful participants reaping the benefits. Furthermore, food industry retailers that adopt lean thinking may develop their own version of lean at a supply chain level, instead of implementing an industry standard. This may affect suppliers negatively if different retailers have different standards and the suppliers need to comply with all of them (Lee *et al.*, 2013; Smith, 2008).

For lean principles to work in a food supply chain context there is the necessity for supply chains to move away from the current ‘trading approach’, where short term profits are gained by introducing competition between suppliers and forcing them to supply products at lowest possible price (Taylor, 2006). In this environment retailers gain the most and farmers gain the least. To avoid this, there is a need for collaboration between participants to find new methods of increasing profit (Taylor, 2006; Dües *et al.*, 2013). Business agreements that promise benefits for all players in the chain are one type of long-term strategy that may be required, without which, the weaker players are not likely to commit to be a part of creating an integrated supply chain (Taylor, 2006).

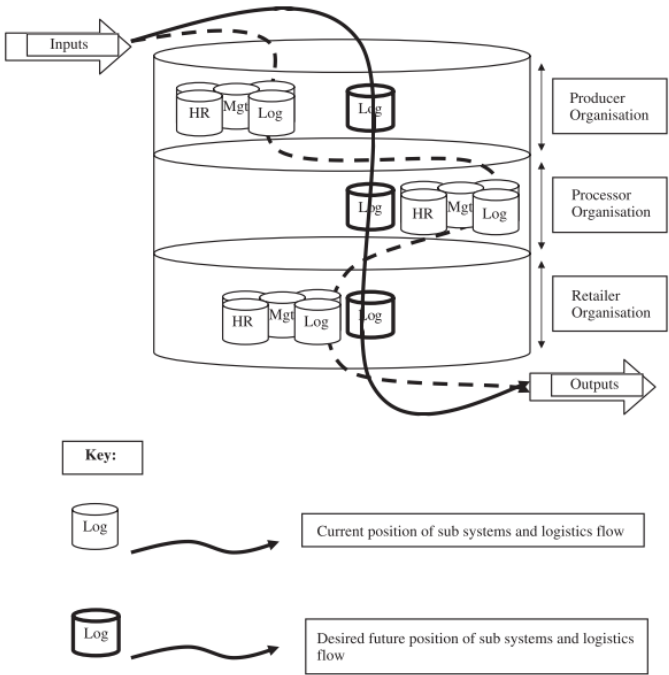


Figure 4. An example of a system with and without lean thinking (Simons and Taylor, 2007, pp.73).

Figure 4 shows an example on how logistics may flow easier through a chain if the participants decide to co-operate and restructure their current design. However, if the system is going to be truly lean then all other categories in the chain must also be managed accordingly, which is very difficult to accomplish (Simons and Taylor, 2007).

3.2.2. Sustainability in food supply chains

There are different drivers that motivate businesses to initiate supply chain collaboration to increase sustainability. The main reason for implementing sustainable thinking in supply chains is due to legal or regulatory requirements as well as customer or stakeholder demand. Moreover, it can also be implemented to cut costs, gain competitive advantage or fix a broken reputation (Seuring and Müller, 2008; Styles *et al.*, 2012a). Sustainable strategies are most efficient when included in the basic corporate strategy (Carter and Rogers, 2008). One separate department working with sustainability is hence not very efficient.

Transparency is a key element in sustainability (Carter and Rogers, 2008). As an example both reputation and legitimacy can be maintained through transparency. If all processes within a supply chain are visible to external and internal stakeholders, they will be able to react to it. These reactions can support the company to improve supply chain processes. For instance social aspects become important for consumers when working conditions and other human right issues comes to light through transparency (Klassen and Vereecke, 2012). Furthermore, sustainability and risk management is closely interlinked since risk management *per se* is a long term view of the business operations to minimise the probability of future costs due to external or internal harm inflicted by the companies operation (Carter and Rogers, 2008).

- **Economic bottom line:** Economic sustainability has issues in terms of measurement for lean incentives. The current financial system is not designed to include ‘the true cost’ of waste and too high inventory for instance (Taylor, 2005). Further, lean will require a lot time for management, such as staff from each part of the chain taking time to meet. In an initial stage this will be a leverage that hopefully will provide benefits in the long run, but it can scare participants in the short run (Taylor, 2005). This challenge must be clearly communicated at once so all members know what will come if they sign up to the agreement. Social and environmental incentives may be expensive to implement but a large proportion of them will result in economic benefits in the long run (Carter and Rogers, 2008; Yang *et al.*, 2011). King and Lenox (2001) found that implementing lean in a production facility might reduce the marginal cost of minimising pollution rates. Additionally, a food supply chain with a well-functioning collaboration may outperform competitors and thereby gain market share (Taylor, 2006).
- **Environmental bottom line:** sustainable benefits of using lean are for instance minimised water and material usage, less consumption of energy and minimisation of hazardous waste (Vinodh *et al.*, 2011). Lean and green management are closely interlinked, but, lean thinking alone will not overall improve environmental performance, since lean and green incentives sometimes conflict (Yang *et al.*, 2011; Hajmohammad *et al.*, 2013). For instance, lean has a just-in-time approach and in food industry that may result in smaller lot sizes that need to be transported more frequently. This is not necessarily good from an environmental point of view (Folinas *et al.*, 2013; Mollenkopf *et al.*, 2010). However, if conflicts like these are recognised then solutions can be found to minimise the negatives (Mollenkopf *et al.*, 2010). According to Dues *et al.* (2011) carbon dioxide emissions is the area where lean and green incentives collide the most, and trade-offs may be required to minimise that, but if the implementation of lean is done with the green aspect in mind, this collision can be avoided. If implemented successfully it can lead to greater benefits than before and also to a more competitive advantage (Dues *et al.*, 2011).

- **Social bottom line:** Pagell and Wu (2009) undertook a case study to see what sustainable companies did different than 'normal' companies. The examples of social aspects found were that companies obligate to:
 - ✓ Always use the same supply base
 - ✓ Traceability of all materials that were used
 - ✓ A transparent view of prices

These aspects indicate long term thinking and equality considerations for all participants in the supply chain (Pagell and Wu, 2009).

From this literature review it was concluded that collaboration amongst all participants in the supply chain is important, both for lean implementation and for sustainable development, to work (Vachon and Klassen, 2008; Kogg and Mont, 2012; Klassen and Vereecke, 2012; Glover *et al.*, 2014). Collaboration will facilitate the environmental part of sustainability (Pagell and Wu, 2009; Dües *et al.* 2013). A consequence of collaboration is that the supply chain is working with a smaller number of suppliers which limits the flexibility (Kogg and Mont, 2012; Smith, 2008). Few suppliers are good from an environmental perspective but it may increase risk and can be associated with increased transaction costs (Kogg and Mont, 2012). If the market moves away from free competition and moves towards collaboration, it could mean fewer jobs available due to efficiency, further, it could also mean that companies lose benefits that can be derived from free competition (Yakovleva, 2007). Instead, there will be a more efficient resource use which is better for the environment and for future generations. These types of trade-offs will be required to achieve a sustainable system (Yakovleva, 2007). One challenge of sustainable development is still the difficulty to measure and compare performance of environmental and social incentives (Styles *et al.*, 2012b; Kogg and Mont, 2012).

“To achieve outstanding triple bottom line performance, new types of economic, social and environmental partnerships are needed. Long standing enemies must shift from mutual subversion to new forms of symbiosis ... Effective, long-term partnerships will be crucial during the sustainability transition” (Elkington, 1999, pp.220).

4. Discussion

There were a limited number of articles available which addressed potentials of lean thinking in food supply chains that also included the sustainable development aspect (as can be seen in Table 1). Therefore the two research questions were difficult to answer properly, with great detail and firm referencing. However, a few key areas were highlighted more often in the literature than others which provided a basic understanding of the topic.

As for the first research question some synergies and conflicts were found. For instance not all lean principles are applicable in food supply chains, as highlighted by Jain and Lyons (2009). They state that the lean model used in automotive industry cannot be transferred unchanged onto food supply chains; it has to be adapted to the situation of food supply chains. For instance, the flow principle where all participants of a supply chain work together for better flow were barely adapted at all in food and drink industries in the UK (Jain and Lyons, 2009). Womack and Jones (2003) also

mention that lean should be driven by a pull demand from consumers and hence change rapidly if the demand changes. Aligning to demand was a second thing current food and drink plants in the UK could not comply with (Jain and Lyons, 2009). This is due to the characteristics of food supply chains, such as long lead times, short shelf life, seasonality and uneven harvest and quality.

Lean as a sustainable incentive was often presented in the literature from different aspects however, most authors focused on environmental aspects only and did not include social aspects to the same extent (Carter and Rogers, 2008; Seuring and Müller, 2008). Mostly highlighted was that lean thinking not only can improve economic performance via optimisation of resource use and waste minimisation, but also environmental performance (Dües et al, 2013; Vinodh *et al.*, 2011), although, they may conflict in some features. For example, there may be a decision between keeping food waste at a low level or keep consumers satisfied by having products available at all times in stores, even if it leads to more waste created in the end.

The second research question about communicated potentials of lean as a sustainable strategy was explored from a participant perspective and a systems perspective. There seems to be contradicting perceptions between the participants in food supply chains, on who has the responsibility to drive sustainable change of food products. Consumers do not think it is their purchase decisions that drive change, while some retailers argue it is (Kneafsey *et al.*, 2013). The fact that no one wants to take responsibility can be seen as a problem for sustainable development in food supply chains. Further, retailers have the most power in supply chains in the UK. They have the means to create sustainable supply chains if they want (Styles *et al.*, 2012b). Although, the widespread distrust towards them may be an obstacle for the development. Another issue that was found was that consumers may require products that are environmentally and ethically produced. However, for processed products that have multiple ingredients the supply base can be both broad and global, and if these products are to be managed accordingly, that will require resources, time and money (Smith, 2008). A benefit of implementing lean thinking that includes TBL aspects is that future risks of a reputation damage connected with environmental or social failure will be mitigated (Carter and Rogers, 2008).

From a systems perspective it was found in the review that collaboration and transparency are vital to increase performance of sustainable development of supply chains; implementation of lean in supply chains; and for the social and environmental part of TBL. Further, if lean is to be successful then short supply chains are desirable (Ugochukwu *et al.*, 2012). Currently food supply chains in the UK are usually long and complex. Cox and Chicksand (2005) strongly critique the applicability of lean in food supply chains and state that in the current environment, retailers will use their market power to increase their profit, at the cost of the other participants in the supply chain. Taylor (2006) has similar findings but suggests that the solution is to move away from the 'trading approach' that occurs and into a system that is more beneficial for all participants. In a long term perspective retailers need their suppliers, and right now, farmers in the UK especially, have a low profitability. If that continues it is likely that they will go bankrupt, which will leave retailers with a limited or declining domestic supply base.

Another aspect of lean is that it requires consideration to customer value throughout the chain, which was defined as always having access to food products all year round, at a low price and sufficient quality. This means for instance that empty shelves are not a good customer value. This is one area where lean, TBL and food supply chains conflict substantially; where satisfying the consumer requires a strategy that increases resource use and potentially creates more food waste.

From the review it became clear that the reasons for initiating sustainable change in corporations sometimes is driven by external factors, such as legislation, consumer demand or to fix a broken reputation (Carter and Rogers, 2008). This implies that a re-design of an existing supply chain into a lean or a more sustainable supply chain perhaps is associated with a lot of work that may or may not pay off, and hence companies tend to avoid such incentives until change is driven by external factors. For instance legislation that prevents food waste going to landfill. More research is needed in this area to establish the true benefits and costs of lean in food supply chains as a sustainable strategy.

This thesis additionally showed that lean and TBL can be implemented simultaneously, the only requirement is that they are both implemented initially, so that lean can be adjusted to include sustainable aspects. The major difficulty however, both with lean and TBL is the problem of measuring the performance of each part for each participant (Styles *et al.*, 2012b; Kogg and Mont, 2012). Therefore, in theory, lean does have the potential to be a sustainable strategy in food supply chains, but in practice the strategy has a lot of problems that needs to be addressed before the strategy can start to perform.

5. Conclusion

In theory, the concept of lean has the potential to become a sustainable development strategy for food supply chains. However, lean needs to be adjusted to fit in an agri-food context. Further, obstacles have been found in practice that will make the implementation of lean difficult. One important aspect found was that collaboration within the whole supply chain is needed for lean to work. Moreover, retailers have the position and power to initiate the implementation of lean, but due to a lack of trust towards them, much work and beneficial agreements for all participants must be developed. Further, short supply chains are preferred in this context, which is not the current case in the UK.

The findings of this thesis are general for all types of food products. One weakness with the study is that it is solely based on secondary data, of which some articles had general findings and some had specific findings for a certain product type and/or a certain food supply chain. Therefore the comparability between articles may not always be truly accurate. Despite these weaknesses this thesis was able to describe the current situation and how lean thinking and sustainable development may be combined to improve the performance of food supply chains.

Future research is needed to establish what the lean strategy should include and which trade-offs are needed for it to be truly sustainable. It will probably also be necessary to have slightly different strategies depending on product type. Moreover, a standard for measuring the performance of lean and TBL must be established within the agri-food industry so that everyone is working with the same rules and regulations.

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