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Circular and Lean Food Supply Chains

Stella Despoudi

Abstract

Circular economy (CE) refers to the industrial economy that aims to achieve enriched sustainability through restorative objects and supply chain design. Many governments have put in place different initiatives in line with the CE. On the other hand, the term Lean operations refers to the reduction of the non-value adding activities and waste in a supply chain. The food sector has been criticized for its sustainability and circularity due to the high levels of food and packaging waste and at the same time the increasing costs. Although food supply chain entities have started to implement circular economy and lean practices, the current efforts do not seem to be sufficient to achieve a circular and lean food system. The aim of this chapter is to explore the possibility of a circular and at the same lean food supply chain.

Keywords: circular economy, lean supply chain, food supply chain, sustainability

1. Introduction

In the past 20 years, interest in the notion of supply chain management has been growing rapidly in both global academia and business world. Behind this are the rapid changes in the global economic environment, the increasing variety of products, the increasing demand for delivery deadlines, the shorter product life cycle and the increasing expectations of consumers for products and services [1]. At the same time, with the continuous development of e-commerce, globalization and offshoring of production, the complexity and related risks of supply chain management also increase [2]. These new factors also promote the increasing interest of enterprises in supply chain management and re-examine their supply chain strategy.

In the early view of supply chain management, the scope of supply chain management is only discussed within the enterprise, and then it gradually derives to the relationship and cooperation between the enterprise and the upstream and downstream enterprises [3]. Moreover, it is no longer confined to the manufacturing industry, for a variety of industries, even the service industry, supply chain management has shown its significance. Today, supply chain management has become a more comprehensive concept. It covers all the processes from raw material suppliers to end customers. All the links that have an impact on cost and satisfying end customer needs are included in the scope of discussion by supply chain management.

However, at the same time, due to the increasing global environmental issues, it also puts forward new topics and higher requirements for modern supply chain management [4]. Since the industrial revolution in the 18th century, human society

has undergone tremendous changes with the development of science and technology. In this process, the production technology is progressing rapidly, the scale of production is expanding constantly, and the production efficiency is advancing rapidly [5–7]. However, the progress of society and science and technology not only brings great economic benefits to people, but also has a tremendous impact on the environment. People blindly pursue economic benefits, thus excessive exploitation of natural resources, not only lead to regional environmental pollution, but also make some global environmental problems such as global warming, biodiversity reduction and marine pollution [8, 9]. Moreover, statistics show that more than 2.4 billion people have been affected by climate-related disasters from 2002 to 2012, an increase of 700 million over the last decade [10]. These environmental issues have threatened the living environment of human beings and will affect the sustainable development of society. As a result, people began to pay attention to the seriousness of environmental problems and try to seek measures for improvement and sustainable development.

Governments in various countries have promulgated laws and regulations to regulate green manufacturing in enterprises in the early 21st century. The EU has promulgated RoHS, WEEE and REACH directives, which regulate the supply chains of different industries from different aspects, requiring them to become a greener supply chain [11]. Meanwhile, some international NGOs are also involved in this series of actions. The International Organization for Standardization has developed ISO14000 series environmental management standards to manage and plan the activities, products and services of all organizations, including global enterprises and social groups [12].

Academia has also paid more attention to and discussed the environmental responsibility of enterprises. Although there are many debates on corporate social responsibility, most scholars agree that enterprises, as an important factor of social composition, are obliged to undertake certain environmental responsibilities [13]. Elkington [14] also put forward the theory of triple bottom line in 1998, which expresses that corporate profit, social responsibility and environmental responsibility are the foundation of enterprises, and also the foundation of enterprises' continuous development and long-term development [14].

Finally, with the waste of resources and the increasingly serious environmental pollution, consumers have also begun to pay more attention to the environmental protection behind products and services [15, 16]. The change of environmental willingness of American consumers from 2008 to 2013. It can be found that 71% of consumers will take environmental factors into account when shopping in 2013, up from 66% in 2008. This means that companies need to meet the growing environmental needs of consumers, so companies also need to make the supply chain greener, which can also enable them to have more competitive advantages in the market competition. In the context of these three factors, enterprises need to make their supply chains more environmentally friendly and sustainable, whether from the perspective of government mandatory supervision, or to meet the needs of consumers, or for the sustainable development of companies.

As an industry closely related to people's daily lives, food industry has huge direct or indirect impact on the environment. Moreover, as an important part of the global economy, the food supply chain is also closely related to the consumption of natural resources and the emission of pollution [17]. At the same time, the research also shows that activities related to food packaging, transportation and waste disposal account for 5–10% of global greenhouse gas emissions, and this figure is expected to continue to rise [18]. On the other hand, food safety is an important topic of global concern, and also the top priority of the food industry. This means that for food companies, under the important premise of ensuring food safety, they

also need to solve the challenges from the environment, so that their supply chain need to have as little impact on the environment as possible [19]. As a result, an environmentally friendly and sustainable supply chain is particularly important for the food industry.

In such an overall environment, many new concepts about supply chain management have emerged, including green supply chain management, sustainable supply chain management, closed-loop supply chain, lean supply chain, reverse logistics and so on. These concepts provide enterprises with a more environmentally friendly supply chain development model from different perspectives, enabling them to re-examine their supply chain strategy [20]. Similarly, circular economy, as a relatively new concept, emphasizes the sustainable use of resources and energy in the economic activities, thereby minimizing its impact on the environment [21]. Another supply chain practice which is hugely involved in the manufacturing industry is the philosophy of Lean production systems from Toyota [22]. The purpose of lean supply chain management to eliminate waste and non-value adding activities by optimizing the supply chain by adopting a wide range of lean practices/tools (e.g. Total productive maintenance, just in time, 5 s, Total quality maintenance and Kanban card). Both lean and circular economy are becoming essential elements for successfully managing supply chains and in particular food supply chains. However, their interrelationship has not been widely discussed especially in the food sector.

2. Lean and circular supply chains

This section starts with a definition of lean production and a discussion of the origins and practices of lean. This is followed by a discussion of the lean tools. After that, the definition of circular economy, the practices of circular economy i.e. 3 Rs, and the definition of the circular supply chain. Then the characteristics of the food supply chain are discussed. The chapter concludes with a critical discussion of the circular and lean supply chain characteristics.

2.1 Definition of lean

Krafcik [23] first introduced the lean concept after studying global automotive manufacturing, with a specific focus on deciphering the inner workings of Toyota's production system. At their core, lean practices aim to streamline the flow of value by systematically reducing waste during the manufacture of a product [23]. However, it was Womack et al. [24] who first produced a consolidated study that claimed that five core lean principles could be applied to every industry [24]. They are:

1. Specifying value creation
2. Identifying the value streams of the production process and eliminating waste
3. Creating flow in the production line from supplier to customer
4. Creating pull, by allowing customer demand to be the driver
5. Striving to achieve the four aforementioned principles through a systematic approach towards continuous improvement

Whilst the lean concept is nothing new, it was observed by Baker [25] that there are few organizations which fully understand the underlying philosophy behind

its key principles [25]. However, Liker [26] identified that for lean production practices to be effective, they needed to be rooted in a people-centric system where employees are directly involved in the identification and implementation of continuous improvement [26]. This organizational approach was also identified by Hines et al. [27], who focused on the idea of Total Quality Management (TQM) [27]. TQM requires the development of an overall organizational culture which moves beyond the production floor. This is demonstrated by the myriad of businesses who have unsuccessfully attempted to implement lean practices. This organisational approach was also identified by Hines et al. [27], who focused on the idea of Total Quality Management (TQM) [27, 28]. Academic studies have looked at such failures, identifying some common factors as responsible for businesses being unable to successfully enact them. These are: the complexity of lean management implementation; the limitations on a successful impact caused as a result of contingency factors; a focus on Just-In-Time (JIT) practices without sufficient consideration for other key aspects of Operations Management (OM); and the lack of attention paid to Human Resource Management (HRM). Further, the difference between those that were successful and unsuccessful was the implementation of 'soft' lean practices, such as small group problem solving, training to complete multiple tasks, supplier partnerships, customer involvement, and continuous improvement.

2.2 Origin of lean production and lean principles

In retrospect, the term Lean Production System (LPS) was introduced into world industry in order to enhance and maximize efficiency throughout manufacturing processes which became a suitable model for modern manufacturing companies to design processes and procedures in their firms. According to Western industry and Japanese industry, Western world industry employed automation, production systems and computer-aided technologies to enhance manufacturing process whereas the Japanese industries invented a customer-value focused method called "Lean Manufacturing" which also known as "Lean production" [29]. It has become a major driving force of modern business' success and has widely accepted by the companies [30].

The philosophy of Lean was originated by Toyota in the 1950s by Taiichi Ohno. The techniques aim to eliminate all the wastes and excess (called as Muda) from the production system. Lean Production has principles to avoid eight causes of waste which are storage, transport, accessibility of processes, unnecessary movement, waiting times, overproduction, tight tolerances, defects and lastly, unused skills of the employees. Lean principles were further developed which includes the following techniques: value of customers, value stream mapping, flow production capability, pull system and eliminate all forms of waste. More supportive evidence by Bicheno and Holweg [31] state wastes as "non-value added" to the companies which are the factors needed to be minimized to zero as much as possible and maintain value-added activities (what customers are willing to pay for) in the same or higher level [31]; Practically, it's inevitable in any businesses that wastes will occur.

VDI [32] commented on lean production as "an enterprise-specific methodical system of rules for the continues orientation of all enterprise processes to the customer in order to achieve the largest by the enterprise management" which can lead to a continuous improvement process (CIP) internally [32]. CIP was defined as a "frame of thought and the proceeding actions for formalized, targeted and progressive improvement of activities." and became significantly important to all firms who interested in leans [33]. In order to be successful in terms of continuous improvement of production, integration of the following principles below is needed where the Lean Production principles' symbols shown by House of Lean Production

in and Tripathi, D. [34], “Relationship between TQM and TPM implementation factors and business performance of manufacturing industry in Indian context”, *International Journal of Quality & Reliability Management* [35]. However, all of these cannot be done or implemented if a company has a wrong mindset with business culture, leadership and coaching.

2.3 Lean production tools/practices

This section will discuss six lean production tools/practices which are: 5 s Total productive maintenance (TPM), Total quality management (TQM), Value stream mapping (VSM), Kanban, and Just in time (JIT).

One of the important topics in implementing lean is lean production tools since lean principles were mentioned in the previous part, to find appropriate tools to be used in organization is essential to achieve those principles. An interesting quote from Abraham Maslow in 1966 for his hierarchy of motivation “It is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail” so as lean tools which all firms need to identify their objective before using any lean tools. This can be observed on SMEs companies; these firms will firstly focus on the most necessary lean practices rather than a piecemeal one where most of them start implementing lean by using these tools such as 5 s, Kanban and Total productive maintenance (TPM). “SMEs should start with minimal financial investment on lean practices such as, Kanban, 5s and Honshin” due to their incapability to implement everything at once, so it’s exceptional to choose the easiest or cheapest. 5S, one of the most common tools in lean because it’s easy to do without the needs of expense. As its name, it has 5 of S which are, Sort, Set-in-order, Scan, Standardize and Sustain. The objective to reorganize workplaces and create a strong mindset for an entire company as a whole in order to maintain workplaces in good condition and promised the employees to be more self-discipline [35]. Another related practice to 5 s is called Total productive maintenance (TPM), “a maintenance program which involves a newly defined concept for maintain plants and equipment” [36].

The benefits of using TPM is to minimize defects, breakdown and accidents as much as possible in all functional workplaces, also involve entire organization to work together as a team by sharing knowledge and experience. Moreover, it shares the same principle to 5 s, which is to keep the workplace clean and sustainable [36]. One of the tools that are worth to mention is Total quality management (TQM), the tool that shares similarities with TPM and often used interchangeably [37]. The main concept of TQM is to have continuous improvement in all work; it means that from strategic planning and decision-making to the execution in the shop floor [38]. The principle of TQM is that mistaken from human, which might be occurred from faulty systems, needed to be prevented from a repetition of the same mistake by establishing the new process.

The next tool is called Value stream mapping (VSM), an effective tool for the practice of lean manufacturing. It is used to visualize the steps needed from the beginning of product creation until delivering to end-customer. The map will help us to identify where in the process is a bottleneck so operators could identify and improve it. Lastly, a well-known lean method called Kanban, aims to minimize inventory at any one time [39]. It is used to indicate when the demand of product is available in the specific circumstances so production can operate in the right time. Kanban system is very popular in Japanese companies due to the cost saving by avoiding overproduction, improving flexibility in each work stations, reducing inventory stock, waiting times and logistics costs. Kanban is one of the methods used to achieve Just-in-time manufacturing (JIT), a management philosophy implemented and designed by Taiichi Ohno, 1998. Just-in-time (JIT) is most widely

adopted and practices recently in several organizations, which aims to have the right items with certain quantity and quantity in the right place and time [40].

2.4 Definition of circular economy

The early thought of circular economy can be tracked back to ‘the spaceship theory’ mentioned by Boulding in ‘Economics of the coming spaceship earth’ in 1966. Boulding [41] stated that in an isolated and closed spacecraft, due to limited resources, if resources are not recycled, it will eventually go to destruction, the same is true of the earth [41]. After Boulding put forward this theory, people began to realize the importance of sustainable development to human beings. Then, in 1989, Pearce and Turner formally and systematically put forward the concept of circular economy, and explained the transition from traditional linear economy to circular economy.

However, since the different proposed antecedents and scopes, different literature give different answers to the definition of circular economy. Circular economy is an economic development mode that minimizes material, energy and environmental damage without restricting economic growth and social and technological progress. Hobson [42] defined circular economy as a regenerative industrial system, which aims to eliminate waste and be regenerate mainly through better design of material, system and business model [42]. Murray et al. [43] claimed that circular economy is an economic model that achieves ecosystem optimization through rational design and management of resources, procurement, production and recycling processes [43].

Although there is no comprehensive and commonly accepted definition of circular economy at present, some common goals are revealed in relevant literature. First of all, most of the definitions of circular economy in the literature mention that circular economy is used to replace the traditional linear economy, and through intentional design and management to make the economic model restorative [44]. Govindan and Hasanagic [45] pointed out that because the traditional linear economy did not consider the impact of natural resources and human resources, such as social capital, the use of circular economy to replace the linear economy can make resources reflect not only economic value but also environmental and social value [45]. Secondly, relevant literature also point out that circular economy is to minimize the waste and damage of natural resources and environment caused by economic development. Thirdly, circular economy aims to improve economic, social and environmental values rather than pursuing economic values alone [46]. Last but not least, at the macro level, circular economy system are more resilient because they rely less on external resources [47]. A common point of most circular economy definitions: closed flow of materials and the use of materials in multiple stages. As a result, the above five points explain the goal of circular economy, and this also gives a clearer framework and direction for this research’s further discussion. Although there is no comprehensive definition of circular economy at present, considering the characteristics of supply chain, this study will follow Murray et al.’s definition: circular economy is an economic model that achieves ecosystem optimization through rational design and management of resources, procurement, production and recycling processes.

2.4.1 “3R” principles

The 3R principles refer to reduction, reuse and recycle. As the core principles in the practice of circular economy, 3R principles have been widely discussed in many studies [48]. In the Circular Economy Promotion Law promulgated by the

Chinese government in 2008, the Chinese government also directly defined circular economy as a reduction, reuse and recycling activity in the process of production, circulation and consumption [49]. Thus, it can be seen the 3R principles are of great significance in the practice of circular economy.

- Reduction principle

Reduction is the first principle in the 3R principles, which means reducing resource consumption and waste generation through better design or management at the production and consumption stage [50]. The purpose of reduction principle is to improve from the source of production stage, so as to reduce materials and energy entering the production and consumption stage. Therefore, the reduction principle is aimed at requiring businesses to start considering material and energy savings and waste reduction at the input end, rather than making great efforts on recycling or waste disposal stage after the waste is generated. For enterprises, there are many measures to implement reduction principle. Using environmentally friendly raw materials, environmentally friendly production methods, simpler packaging design and more compact and lightweight product design are all effective ways for enterprises to implement reduction principle. Enterprises can also better apply the principle of reduction by improving their ecological efficiency, although ecological efficiency also plays a positive role in the other two principles.

- Reuse principle

Reuse principle refers to the reuse of product or product packaging in an initial form as many times as possible and in various forms, so as to prevent it from becoming waste too early. Extending the service life of products as far as possible is also a requirement of the reuse principle. The implementation of the reuse principle means that companies can save a lot of resources, labor and energy to manufacture new products or components and packaging of products [51]. However, the principle of reuse also puts forward a higher requirement for companies. Prendeville et al. [52] pointed out that the company not only needs to be able to design products with longer service life, but also needs to consider how to encourage consumers to recycle and reuse products or packages [52]. Therefore, it also shows that the principle of reuse not only puts forward certain requirements for enterprises, but also depends on the attitude and participation of consumers. In the process of implementing reuse principle, all stakeholders need to participate, including consumers' recycling and reuse of products and packaging.

- Recycle principle

The recycle principle refers to the recycling of wastes as much as possible through the reprocessing of wastes, so that they can be converted into useful resources and thus reduce the generation of non-recyclable garbage [53]. There are also two ways of recycling wastes: primary recycling and secondary recycling. Henshaw et al. [54] mentioned that primary recycling refers to recycling and processing waste to form new products or packages identical to the original (such as using scrap steel to produce new steel) [54], while secondary recycling refers to using waste as raw materials for other products with different properties without considering the original properties of waste. The principle of recycling can be used to control the end of the waste generation,

so that the waste can be re-entered into the production or consumption stage, which also reduces the possible environmental pollution. However, once a company pays too much attention to the recycling process and achieves good results, it will not be interested in controlling the amount of waste.

2.5 Definition of circular supply chain

Under the trend of globalization, the importance of supply chain management has become increasingly prominent. Many scholars even emphasize that the competition among enterprises today is the competition among supply chains [55]. At the same time, how to make the supply chain greener and more sustainable has become a key issue under the situation that all parties are paying more and more attention to environmental protection [56, 57]. With the continuous development of circular economy concept, an increasing number of scholars begin to study the application and practice of circular economy in various fields and levels. As a result, the application of circular economy in supply chain has naturally become a hot research topic.

When discussing the concept of circular supply chain, many scholars will compare several concepts of supply chain sustainability with that of circular supply chain [58]. These concepts related to supply chain sustainability are mainly reverse logistics, green supply chain, sustainable supply chain and closed-loop supply chain. Although these concepts cannot fully contain the meaning of the circular supply chain, the four concepts each contain some scopes and circular flows of the circular supply chain. Reverse logistics enables products or materials to flow reversely from consumers, the end point of the supply chain, to each node of the supply chain along the supply chain channel, so that discarded or damaged products can regain their value and avoid becoming waste. The definition of green supply chain refers to the purpose of minimizing the impact on the environment from raw material acquisition, processing, production, packaging, warehousing, transportation, consume to scrap disposal [59]. Sustainable supply chain management emphasizes a broader and comprehensive supply chain strategic management, taking into account the environmental, economic and social factors in supply chain management, so as to achieve the goal of long-term sustainability of the supply chain [60]. Finally, as a relatively new concept, closed-loop supply chain integrates the forward and reverse supply chains and covers the whole life cycle of products from cradle to grave, in order to close the flow of materials and reduce pollution and waste generation [61].

The above concepts of supply chain sustainability include some circular flows of the circular supply chain, but not all scopes and circular flows. The model of circular supply chain needs to be extended on the basis of closed-loop supply chain, and the extension point is the scope and focus of material recovery system. For the scope, post-production management should be taken into account in the circular supply chain so as to include open-loop in the supply chain; for the focus, the value chain system of the circular supply chain also needs to be derived from the related by-product synergies and waste recovery flows. As a result, Batista et al. [58] defined the circular supply chain as “The coordinated forward and reverse supply chains via purposeful business ecosystem integration for value creation from products or services, by-products and useful waste flows through prolonged life cycles that improve the economic, social and environmental sustainability of organisations.”

2.6 Characteristics of food supply chain

Food industry as an industry closely related to people's daily life, because of the particularity of food itself, food supply chain also has many different

characteristics. Maloni and Brown [62] pointed out that due to the food safety and hygiene, the product quality requirements of food supply chain are strictly regulated [62]. At the same time, food supply chain is also highly dependent on the environment because of its vulnerability to deterioration. Similarly, due to the limitation of shelf life, the change of raw materials, semi-finished products and final product quality change is also a challenge for the food supply chain. Moreover, Papaioannou et al. [63] also stated that the food supply chain has inherent uncertainties in demand, process and suppliers [63]. First of all, it is not easy to forecast the demand of customers, and the food supply chain also needs to face further challenges from the disturbance of weather changes and customer preference changes. At the same time, due to yield changes, seasonal factors, some perishable food and other factors, its supply and production and storage process will also face certain uncertainties and risks.

3. Circular and lean food supply chain

Today's business environment is a very dynamic one with the rapidly changing consumer preferences, which pressures the business to respond to customers' needs and wants, become more sustainable, and cost efficient. In recent years, sustainability has become an emerging goal of food supply chain due to the sustained attention of various aspects to environmental issues. According to Consumers are increasingly interested in the sustainability behind products (raw materials, procurement, packaging and transportation). In addition, due to the pressure of government regulation and consumers' increasing awareness of environmental issues in consumption, many enterprises are forced to turn their supply chain model into a circular supply chain. However, the circular food supply chain can also bring many other benefits to the company. For instance, Beske et al. [64] pointed out that circular supply chain can help companies provide consumers with higher quality and safer food [64]. Geissdoerfer et al. [65] also mentioned that the circular supply chain can reduce food waste, improve brand benefit and increase long-term profits [65–67]. As a result, food companies need to use a circular supply chain to improve their customer loyalty and competitive advantage.

At the same time, some scholars also discussed challenges faced by the circular food supply chain. Carbon emissions and other environmental pollution of the food supply chain (waste cooking oil supply chain) after the implementation of the circular supply chain and concluded that the impact of the supply chain on the environment has been significantly reduced, but the short-term economic benefit is still a challenge. Food waste is caused by food packaging, so food packaging is a challenge for the circular supply chain. In addition, many farmers in developing countries generally lack sustainable knowledge, which may affect the implementation of the circular supply chain. Finally, weak regulation of laws and regulations, lack of pressure from the market and lack of support from other stakeholders in the supply chain are all challenges faced by the circular food supply chain. Circular economy brings the advantages renewability, reuse and recycling that the food sector needs.

On the other hand, lean supply chain provides food companies with a series of practices that optimize supply chains through more efficient routes and usage of materials, cost efficiency and better management of customer demand. Due to the simplicity of lean principles, high productivity, short lead-time, and improved overall efficiency were able to replace the decline of Computer Integrated Manufacturing (CIM) and became the standard of today's manufacturing practice.

Many research studies carried out in manufacturing industries showed that the owners are likely to adopt lean principles to the production due to the advantages that they acquire regardless of its scale. This is because either small or large business has its advantages of lean principles. The biggest size of SMEs is taken place in China with less than 999 employees, where in EU & UK estimated should be less than 250 employees. SMEs aim to have a better relationship with higher flexibility and strong work communication internally to have a simple and clear infrastructure for everyone to follow. On the contrary, large businesses aim to find access to resources and exploit them which will allow them to capitalize a market with a better lean supply chain than SMEs.

Lean production can help to reduce inventories for manufacturers since high inventories can result in inventory costs and available workplaces are minimized. Also, it can decrease any unnecessary times in supply chains such as lead times for customers, changeover time in using machineries and idle time of workers and educate managerial skills to upper managers and improved unskilled workers in the production. Applying lean principles, company will gain advantages in terms of increasing availability of machines and reducing manpower, bettering work environment in terms of higher safety and more organized workplace and also, more cost saving and higher profits as all potential wastes are eliminated, all hidden will also be eliminated.

Nevertheless, even though there are many advantages from applying lean principles, there are barriers obstructing lean productions to be implemented, which taken in accounts every organizations. Lean production is not suitable for applications that have high variations of customer demands and highly customized product. This is because lean principle aims to balance the flow production, which cannot respond to the rapid change in demand fluctuation. Thus, the lean idea such as Just-In-Time (JIT) can be ambiguous to be implemented in the production. Availability of supplies can also cause trouble since lean aims to keep only a small amount of inventory in the production in order to minimize unnecessary cost. This will trouble companies if unexpected circumstances occur such as employee strikes, error on products and transportation delays which can damage customer relationships and whole supply chains. Another factor is financial plan since it needs huge investment to develop regard to training cost, purchasing cost and takes huge amount of time to revolutionize entire organizations to have strong mindset; some employees are not willing to change their traditional way of working and afraid to make any mistakes regard to the new system.

4. Conclusion

The purpose of this chapter was to discuss the possibility of having circular and lean food supply chains. The chapter started with an introduction to the need for circular and lean food supply chains. Then this was followed with the definition of lean production, a discussion of the origins and practices of lean and the lean tools. After that, the definition of circular economy, the practices of circular economy i.e. 3 Rs, and the definition of the circular supply chain were explained. Then the characteristics of the food supply chain were discussed. The chapter concludes with a critical discussion of the circular and lean supply chain characteristics. It is evident that both approaches can be combined in order to bring the ideal and desirable food supply chain of the future. Of course, none of them is panacea, and therefore food companies that wish to implement such practices need to adapt them to their own needs and abilities.

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References

- [1] Stadtler, H. (2014). Supply Chain Management: An Overview. Springer Texts in Business and Economics, pp.3-28.
- [2] Gereffi, G. and Lee, J. (2012). Why the World Suddenly Cares About Global Supply Chains. *Journal of Supply Chain Management*, 48(3), pp.24-32.
- [3] Simatupang, T. and Sridharan, R. (2005). The collaboration index: a measure for supply chain collaboration. *International Journal of Physical Distribution & Logistics Management*, 35(1), pp.44-62.
- [4] Fahimnia, B., Sarkis, J. and Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. *International Journal of Production Economics*, 162, pp.101-114.
- [5] Spanaki, D, Karafili, E, Despoudi, S. (2019) Data Sharing in Agriculture 4.0: Concepts and Challenges, EurOMA Conference 2019 – Finland.
- [6] Spanaki, K; Sivarajah, U; Fakhimi, M; Despoud, S; Irani, Z, (2021a) Disruptive Technologies in Agricultural Operations: a meta-review of AgriTech and AI Research, *Annals of Operations Research*, In press.
- [7] Spanaki, K; Karafili, E; Sivarajah, U; Despoud, S; Irani, Z (2021b) Artificial intelligence and food security: swarm intelligence of AgriTech drones for smart AgriFood operations, *Production Planning and Control*, In press.
- [8] Despoudi, S, Papaioannou, G, Dani, S (2020a) Producers Responding to Environmental Turbulence in the Greek Agricultural Supply Chain: Does Buyer Type Matter?, *Production Planning and Control*, <https://doi.org/10.1080/09537287.2020.1796138>
- [9] Despoudi, S., (2020b). Green Food Supply Chain, In Galanakis, C. (Ed) *Food Industry and the Environment* <https://doi.org/10.1016/B978-0-12-816449-5.00002-3>.
- [10] Munich Re (2013). RISKS AND CHANCES OF CLIMATE CHANGE. [online] Available at: https://iimi.com/images/Berlin2015/3Pressies/16.09._09.40_Hoeppe_Handout.pdf
- [11] Koh, S., Gunasekaran, A. and Tseng, C. (2012). Cross-tier ripple and indirect effects of directives WEEE and RoHS on greening a supply chain. *International Journal of Production Economics*, 140(1), pp.305-317.
- [12] Montabon, F., Melnyk, S., Sroufe, R. and Calantone, R. (2000). ISO 14000: Assessing Its Perceived Impact on Corporate Performance. *The Journal of Supply Chain Management*, 36(2), pp.4-16.
- [13] Bondy, K., Moon, J. and Matten, D. (2012). An Institution of Corporate Social Responsibility (CSR) in Multi-National Corporations (MNCs): Form and Implications. *Journal of Business Ethics*, 111(2), pp.281-299.
- [14] Elkington, J. (1998). ACCOUNTING FOR THE TRIPLE BOTTOM LINE. *Measuring Business Excellence*, 2(3), pp.18-22.
- [15] Despoudi, S., Papaioannou, G., Saridakis, G. & Dani, S. 2018. Does collaboration pay in agricultural supply chain? An empirical approach. *International Journal of Production Research*, 56, 4396-4417.
- [16] Despoudi, S., 2016. An Investigation of the Collaboration – Postharvest Food Loss Relationship and the Effect of the Environmental Turbulence Factors. Loughborough University. <https://>

dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/21785/1/Thesis-2016-Despoudi.pdf

[17] Halkier, B. (2001). Risk and food: environmental concerns and consumer practices. *International Journal of Food Science and Technology*, 36(8), pp.801-812.

[18] Vermeulen, S., Campbell, B. and Ingram, J. (2012). Climate Change and Food Systems. *Annual Review of Environment and Resources*, 37(1), pp.195-222.

[19] Ala-Harja, H. and Helo, P. (2014). Green supply chain decisions – Case-based performance analysis from the food industry. *Transportation Research Part E: Logistics and Transportation Review*, 69, pp.97-107.

[20] Masi, D., Day, S. and Godsell, J. (2017). Supply Chain Configurations in the Circular Economy: A Systematic Literature Review. *Sustainability*, 9(9), p.1602.

[21] Ghisellini, P., Cialani, C. and Ulgiati, S. (2016). A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production*, 114, pp.11-32.

[22] Vinodh, S., Prakash, N.H. and Selvan, K.E. (2011), "Evaluation of leanness using fuzzy association rules mining", *International Journal of Advanced Manufacturing Technology*, Vol. 57 No. 1, pp. 343-352.

[23] Krafcik, J., 1988. Triumph of the lean production system. *MIT Sloan Management Review*, 30(1), pp. 41-52.

[24] Womack, J., Jones, D. & Roos, D., 1990. *The Machine That Changed the World*. New York: Rawson Associates.

[25] Baker, P., 2002. Why is lean so far off?. *Works Management*, Volume October, pp. 1-4.

[26] Liker, J., 2004. *The Toyota Way: 14 management principles from the world's greatest manufacturer*. New York: McGraw Hill Professional.

[27] Hines, P., Martins, A. & Beale, J., 2004. Testing the boundaries of lean thinking: Observations from the legal public sector. *Public money and management*, 28(1), pp. 35-40.

[28] Bateman, N., 2005. Sustainability: the elusive element of process improvement. *International Journal of Operations & Production Management*, 25(3), pp. 261-276.

[29] Sanders, A., Elangeswaran, C. & Wulfsberg, J., 2016. Industry 4.0 Implies Lean Manufacturing: Research Activities in Industry 4.0 Function as Enablers for Lean Manufacturing. *Journal of Industrial Engineering and Management*, 9(3), pp. 811-833.

[30] Kolberg, D. & Zuhlke, D., 2015. Lean Automation enabled by Industry 4.0 Technologies. *IFAC Conference*, pp. 1870-1875.

[31] Bicheno, J. and Holweg, M. (2009). *The Lean Toolbox: The Essential Guide to Lean Transformation*. Buckingham: Production and Inventory Control, Systems and Industrial Engineering (PICSIE) Books.

[32] The Association of German Engineers (VDI). (2012). *Guideline 2870-1 – Lean Production Systems – Basic principles, introduction and review*. Beuth, Berlin.

[33] Thomas MASCHEK, Khashayar KHAZRAEI, Sabine HEMPEN and Jochen DEUSE. (2011). *Managing Continuous Improvement Process as an Organizational Task in*

Course of a Century, Chair of Industrial Engineering, Dortmund, Germany: Technische Universität Dortmund.

[34] Seth, D. and Tripathi, D. (2005), "Relationship between TQM and TPM implementation factors and business performance of manufacturing industry in Indian context", *International Journal of Quality & Reliability Management*, Vol. 22 No. 3, pp. 256-277.

[35] Sui Pheng, L. (2001). Towards TQM – integrating Japanese 5-S principles with ISO 9001:2000 requirements. *The TQM Magazine*, 13(5), pp.334-341.

[36] Venkatesh, J. (2005). An Introduction to Total Productive Maintenance (TPM), The Plant Maintenance Resource Center, pp 2-3

[37] Seth, D. and Tripathi, D. (2005), "Relationship between TQM and TPM implementation factors and business performance of manufacturing industry in Indian context", *International Journal of Quality & Reliability Management*, Vol. 22 No. 3, pp. 256-277.

[38] Hashimi, K. (2012). Introduction and Implementation of Total Quality Management (TQM) - iSixSigma. [online] iSixSigma. Available at: <https://www.isixsigma.com/methodology/total-quality-management-tqm/introduction-and-implementation-total-quality-management-tqm/>

[39] Rahman, N., Sharif, S. and Esa, M. (2013). Lean Manufacturing Case Study with Kanban System Implementation. *Procedia Economics and Finance*, 7, pp.174-180.

[40] D. K. Singh and Dr. Satyendra Singh. (2013). JIT: A Strategic Tool of Inventory Management, *International Journal of Engineering Research and Applications (IJERA)* ISSN: 2248-9622, Vol. 3, Issue 2, March -April 2013, pp.133-136

[41] Boulding, K.E., 1966. The economics of the coming spaceship earth. In: Jarrett, H. (Ed.), *Environmental Quality in a Growing Economy: Essays From the Sixth RFF Forum*. Routledge, pp. 3-15.

[42] Hobson, K. (2015). Closing the loop or squaring the circle? Locating generative spaces for the circular economy. *Progress in Human Geography*, 40(1), pp.88-104.

[43] Murray, A., Skene, K. and Haynes, K. (2015). The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. *Journal of Business Ethics*, 140(3), pp.369-380.

[44] Mendoza, J., Sharmina, M., Gallego-Schmid, A., Heyes, G. and Azapagic, A. (2017). Integrating Backcasting and Eco-Design for the Circular Economy: The BECE Framework. *Journal of Industrial Ecology*, 21(3), pp.526-544.

[45] Govindan, K. and Hasanagic, M. (2018). A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective. *International Journal of Production Research*, 56(1-2), pp.278-311.

[46] Despoudi, S. & Dora, M. (2020c) Circular food supply chains. 2020 Institute of Food Science and Technology.

[47] Geng, Y. and Doberstein, B. (2008). Developing the circular economy in China: Challenges and opportunities for achieving 'leapfrog development'. *International Journal of Sustainable Development & World Ecology*, 15(3), pp.231-239.

[48] Lieder, M. and Rashid, A. (2016). Towards circular economy implementation: a comprehensive review in context of manufacturing

industry. *Journal of Cleaner Production*, 115, pp.36-51.

[49] Cecc. (2008). Circular Economy Promotion Law of the People's Republic of China (Chinese and English Text) | Congressional-Executive Commission on China. [online] Available at: <https://www.cecc.gov/resources/legal-provisions/circular-economy-promotion-law-of-the-peoples-republic-of-china-chinese>

[50] Ying, J. and Li-jun, Z. (2012). Study on Green Supply Chain Management Based on Circular Economy. *Physics Procedia*, 25, pp.1682-1688.

[51] Castellani, V., Sala, S. and Mirabella, N. (2015). Beyond the throwaway society: A life cycle-based assessment of the environmental benefit of reuse. *Integrated Environmental Assessment and Management*, 11(3), pp.373-382.

[52] Prendeville, S., Sanders, C., Sherry, J., Costa, F., 2014. Circular Economy: Is it Enough? [online] Available at: https://www.researchgate.net/profile/Sharon_Prendeville/publication/301779162_Circular_Economy_Is_it_Enough/links/5727a2be08aef9c00b8b4ddd.pdf

[53] Ying, J. and Li-jun, Z. (2012). Study on Green Supply Chain Management Based on Circular Economy. *Physics Procedia*, 25, pp.1682-1688.

[54] Henshaw, J., Han, W. and Owens, A. (1996). An Overview of Recycling Issues for Composite Materials. *Journal of Thermoplastic Composite Materials*, 9(1), pp.4-20.

[55] Storey, J., Emberson, C., Godsell, J. and Harrison, A. (2006). Supply chain management: theory, practice and future challenges. *International Journal of Operations & Production Management*, 26(7), pp.754-774.

[56] Brandenburg, M. and Rebs, T. (2015). Sustainable supply chain

management: a modeling perspective. *Annals of Operations Research*, 229(1), pp.213-252.

[57] Geng, Y., Zhu, Q., Doberstein, B. and Fujita, T. (2009). Implementing China's circular economy concept at the regional level: A review of progress in Dalian, China. *Waste Management*, 29(2), pp.996-1002.

[58] Batista, L., Bourlakis, M., Smart, P. and Maull, R. (2018). In search of a circular supply chain archetype – a content-analysis-based literature review. *Production Planning & Control*, 29(6), pp.438-451.

[59] Mishra, N., Kumar, V. and Chan, F. (2012). A multi-agent architecture for reverse logistics in a green supply chain. *International Journal of Production Research*, 50(9), pp.2396-2406.

[60] Zorzini, M., Hendry, L., Huq, F. and Stevenson, M. (2015). Socially responsible sourcing: reviewing the literature and its use of theory. *International Journal of Operations & Production Management*, 35(1), pp.60-109.

[61] Govindan, K. and Soleimani, H. (2017). A review of reverse logistics and closed-loop supply chains: a Journal of Cleaner Production focus. *Journal of Cleaner Production*, 142, pp.371-384.

[62] Maloni, M. and Brown, M. (2006). Corporate Social Responsibility in the Supply Chain: An Application in the Food Industry. *Journal of Business Ethics*, 68(1), pp.35-52.

[63] Papaioannou, G., Mohammed, A., Despoudi, S Saridakis, G, Papadopoulos, T. 2020 The role of adverse economic environment and human capital on collaboration within agri-food supply chains, *International Journal of Information Management*, 52, <https://doi.org/10.1016/j.ijinfomgt.2020.102077>.

[64] Beske, P., Land, A. and Seuring, S. (2014). Sustainable supply chain management practices and dynamic capabilities in the food industry: A critical analysis of the literature. *International Journal of Production Economics*, 152, pp.131-143.

[65] Geissdoerfer, M., Savaget, P., Bocken, N. and Hultink, E. (2017). The Circular Economy – A new sustainability paradigm?. *Journal of Cleaner Production*, 143, pp.757-768.

[66] Despoudi, S. (2019) 8 - Optimized food supply chains to reduce food losses. *Saving Food Production, Supply Chain, Food Waste and Food Consumption*, 227-248.

[67] Despoudi, S, (2021) Challenges in reducing food losses at producers' level: the case of Greek agricultural supply chain producers, *Industrial Marketing Management*, in press, <https://doi.org/10.1016/j.indmarman.2020.09.022>