# Applying Lean Thinking to Reduce Uncertainty and Waste in Global Food Supply Chain


## Abstract

The purpose of the study is to examine the adoption and implementation of lean thinking in food supply chains. Since the majority of food companies are small and medium food enterprises (SMEs), a lean action plan was developed taking into account the particularities of SMEs. The methodology used was a case study research of a UK tea company. An action research approach was adopted to study the lean process and diagnosis of problems occurred during lean implementation. The present study developed a lean action plan with three stages: (a) Planning for lean (b) interim lean diagnosis and (c) Lean Operations and control. The first stage includes the following steps: find a change agent, get the knowledge, find a lever, and suspend grand strategy. Interim lean diagnosis revealed issues with top management support, expert knowledge, and operational easiness. The last stage, lean operations and control includes the following steps: (i) Re-Define Value, (ii) Map Process Activities & Value Streams, (iii) Detect Waste, (iv) Develop an Ideal State of Production & Supply Chain Operations, and (v) Control lean operations. The potential contribution of leaning food small and medium companies can be enormous given the percentage of food waste across supply chains. The contribution of this study is threefold: (a) it develops a new lean action plan for small and medium companies. (b) it sheds light on how lean thinking can be applied in the food sector and achieve substantial waste reductions (c) it tests a unique reflecting methodology using action case research to gather, interpret, and develop reflective learning.



**Keywords**: Lean Thinking, Lean Action Plan, Global Supply Chains, Tea Industry, Case Research, Action Research, Value, Value Stream, Waste Reduction, SMEs

## Introduction

In times of uncertainty, companies search for ways to contribute to sustainable development without jeopardising quality. Lean practices relate to waste reduction in ways that do not simply reduce waste, but in doing so add to the value offered to customers (Womack and Jones, 2005). Lean Thinking is a set of principles, philosophies, and business processes that enable the elimination of waste and add value to customers (Tsasis and Bruce-Barrett, 2008). It is based upon the Toyota Production System (TPS) that has focused on simultaneously eliminating waste and improving customer satisfaction (Pegels, 1984). According to lean thinking, waste can be anything other than the equipment, materials, parts, space, and working time required to provide the service.

Since their adoption by Toyota, lean practices and tools have become popular among large companies. However, small and medium companies can also learn and benefit from the application of lean practices and tools to detect and reduce waste (Womack and Jones, 1996a). Although the origins of Lean Thinking stem from large manufacturing companies, with the Toyota Production System being a yardstick of the practice, small and medium companies in manufacturing and service have implemented Lean Thinking in a successful manner (Womack, 2004; Cuatrecasas, 2004; Cookson et al., 2011).

Waste is not new in food sector but its elimination requires a systematic way of thinking. The Food and Agriculture Organization (FAO) of the United Nations stretched the impact of food losses and waste across the supply chains on its efforts to combat hunger, raise income, improve food security, foster economic development and protect the environment (Gustavsson et al., 2011). FAO further estimates that roughly one-third of all edible food produced for human consumption, about 1.3 billion metric tons, is wasted or otherwise lost from the food supply per year (Gustavsson et al., 2011). Although a recent European Union (EU) study recognized that obtaining reliable data on food waste was a

recurring obstacle, the study estimated annual food waste in the EU at approximately 179 kg per person (Bio Intelligence Service, 2010). Buzby and Hyman (2012) estimated total value of food loss at the retail and consumer levels in the United States as purchased at retail prices to be £111.1 billion in 2008.

Food waste can occur at any point of the supply chain (Bourlakis et al. 2011; Gustavsson et al., 2011). At harvesting, waste may include crop damaged during harvesting or edible crops left in field and deteriorate. Post-harvest food waste includes food loss due to decrease in food quantity or quality and spoilage of perishable food that deteriorates to the point in which it is not edible or safe to consume. In processes such as threshing, drying, primary processing, cleaning, classification, transportation, distribution, and storage, food waste may happen due to loss through poor techniques, facilities or infrastructure, process losses, contamination, and poor handling. Finally, retail and post-consumer losses include food wasted from activities and operations such as short life cycles, that may create confusion over 'best before' and 'use by' dates to consumers and poor food preparation technique (Gustavsson et al., 2011).

Therefore, the leaning of food supply chains can have an enormous economic, social, and environmental impact (Vlachos, 2011). However, the majority of companies in the food sector are Small and Medium Enterprises (SMEs). According to Eurostat, Europe Union's food market is made up of about 310 000 companies, 99% of them are small companies generating a relatively low proportion of value added (45.5 %) in the food sector compared to large companies (Eurostat, 2012). Value wasted throughout the supply chain and production operations is one of the reasons for the low value added of SMEs (Fotopoulos et al. 2010).

Lean practices can eliminate waste better than the non-systematic, empirical methods that SMEs often use (Kumar et al. 2006). According to lean thinking, there are different types

of waste that can be addressed and eliminated. Therefore, lean practices could potentially be a solution for the wasted value in the food supply chains. However, despite many successful lean implementations, companies often fail to apply lean tools and techniques. Therefore, it is essential to understand how SMEs attempt to implement lean tools in order to develop a successful lean action plan. There is paucity of empirical research in this area. The research contribution of the present work is a new lean action plan that can be adopted by small and medium enterprises, particularly by those operating in the food sector. The practical contribution of leaning the production and supply chain operations in SMEs can be enormous given the percentage of food waste across supply chains. Further, since most food ingredients are globally sourced, this study contributes to examine global food supply chains linking production in developing regions with markets in developed countries. This study examined a case company from a United Kingdom (UK) tea industry, an industry with high value and ingredients sourced from overseas. Therefore, there is a potential contribution in understanding how to apply lean thinking in global food supply chains. Although the scope of the research questions could be generalised to SMEs from any industry, this study's research scope is the food industry.

The paper has five sections, including this introduction. Section 2 provides a brief review of lean tools and techniques, the lean action plan, and unsuccessful lean implementations. Section 2 concludes with a review of the UK tea industry. Section 3 describes the research methodology, justifies the selection of action case research, discusses the research design, the types and sources of evidence and presents briefly the case study. The findings from the action research are reported in Section 4. Section 5 discusses the implications of the findings for practitioners and researchers, draws conclusions, presents limitations and offers suggestions for future research.

## Literature Review

There is consensus that lean techniques can eliminate waste and reduce risk to manufacturing and services sectors including construction (Howell and Ballard, 1998), aerospace field (Hines et al., 2004), services (Bortolotti and Romano, 2012; Suárez-Barrazaa et al., 2012), tourism (Vlachos and Bogdanovic, 2013), hospitals (Reijula, 2012; Young and McClean, 2008), and public administration (Radnor and Walley, 2008).

Despite the lack of a universal definition of lean thinking (Shah and Ward, 2007), there is consensus that the adoption of lean thinking has a twofold impact on the way companies do business: (a) at the strategic level, lean thinking helps companies to define what value is, and (b) at the operational level, lean thinking provides a set of tools and techniques how to eliminate waste (Hasle et al., 2012). Implementing lean thinking needs a clear understanding of what lean is and what constitutes a successful lean action plan. The remaining of this section reviews key lean concepts and techniques, introduces the lean action plan, reviews unsuccessful lean implementation, and briefly presents the UK tea industry.

## Lean tools and Techniques

Lean thinking focuses on the removal of obstacles ("wastes") that hinder unremitting flow of work processes (Liker, 2004, p.31). According to lean thinking, there are seven types of wastes (**Table 1**). Womack and Jones (1996a) developed the "The five steps model" which assumes that there are five consecutive sets of actions from value to perfection which transform problematic, operational practices into well organised flows of goods and services. Defining 'Value' is the first step in lean thinking. Value can only be defined by the ultimate end customer. The second step is the identification of the Value Stream by breaking down value adding activities into individual steps. In this way, value stream provides the possibility to recognize actions which represent or create "waste". The elimination of waste gives the

possibility for process re-engineering and the creation a continuous “Flow”. Companies then are able to develop a “Pull” system in which the customer, not the company, is the one who triggers the production, thus goods and services reach the customer only when asked for; neither before nor after requested. The final step is a step into “Perfection”, which is the complete elimination of waste so that all activities along a value stream create value. In many cases, lean transformations are radical changes that need a supportive organisational culture in order to be successful (Womack and Jones, 1996b; Tsasis and Bruce-Barrett, 2008).

There is a number of lean tools available for companies to use, including SMED (Single Minute Exchange of Dies) and Value Stream Mapping (Shingo, 1985). A piecemeal, unsystematic application of a single lean tool or technique may reduce waste in business processes without obstructing business as usual. However, lean thinking is much more than implementing a lean tool: it is a set of principles and a business philosophy (Tsasis and Bruce-Barrett, 2008). The real impact of lean tools can be realized when they are implemented as part of a lean action plan. In this way, lean endeavours can bring systematic and sustainable results by reducing waste and increasing value to customers.

**Table 1 Seven Types of Wastes**

| No | Waste | Description |
|---|---|---|
| 1 | Overproduction | Often regarded as the most serious waste affecting quality and productivity and lead times. Excess work-in-progress stocks and quality defects not detected early enough. |
| 2 | Waiting | Occurs when goods are not moved or not worked on. Waiting can be used for training purposes and maintenance. |
| 3 | Transport | Excessing movement may cause damage and deterioration, excessive reporting, bureaucracy and necessitate corrective actions |
| 4 | Inappropriate processing | Simple processes are dealt with complex solutions i.e. complex machinery, expensive technologies etc. which are inflexible and hard to manage/handle resulting in overproducing to recover the investment and unnecessary transport. |
| 5 | Unnecessary inventory | It increases lead times and space/storage, requires huge investment in fixed capital, often acting as covers-up of managerial and operational problems |
| 6 | Unnecessary motion | Refers to poor ergonomics forcing operators to unnecessary, |

| | | |
|---|---|---|
| | | avoidable movements like stretching bending and picking up. It tires employees, leads to fatigues and poor productivity. |
| 7 | Defects | Defects are direct costs that Toyota sees as opportunities to improve to a better (ideal) state of operations |

**Lean Action Plan**

There is no more than scarce evidence on how to manage the change from defining value towards lean perfection (Simon and Canacari, 2012; Slomp et al. 2009; Womack, 2004). For example, Wan and Chen (2009) proposed that after an organisation makes a commitment to implement lean, the journey to lean includes three major activities: lean training, Value stream mapping, and lean assessment. Wan and Chen (2009) pointed out that extensive knowledge and experiences are needed for identifying the correct lean tools, thus lean assessment can be considered as a step of a learning process that helps companies to evaluate what went wrong, learn from their mistakes, and expand their knowledge via lean training. Womack and Jones (2003, pp. 247–255) proposed a broader perspective of lean transformation which includes the following steps:

1. **Find a lean change agent**: This person should be the manager for the transformation project until its successful completion. The lean agent should take specific actions in cultivating the lean culture, leading, managing and educating the personnel about lean tools and techniques.

2. **Get the knowledge**: How to apply lean tools is not widespread known to senior managers and this can be a barrier in creating the lean culture as well as diagnose problems and devise solutions.

3. **Find a lever by seizing a crisis or creating one**: Lean transformation can bring radical changes and create resistance to change. A crisis can be an opportunity for change and lean agents should take advantage of it to initiate the lean changes. Creating and selling

a crisis can help a lean change, yet it can inflame resistance to change if the lean agent does persuade the personnel for its cause.

4. **Forget grand strategy for the moment**: The change that lean brings to operations can be radical to the extent to which the focus should be on the process itself than the business strategy. For example, identification of non-value added activities requires micro-management rather than strategic thinking.
5. **Map your value streams**: The identification of waste requires detailed information about the value streams and identification of all value-added and non-value-added activities.
6. **Begin as soon as possible with an important and visible activity**: A quick start and easy wins can create confidence in the process.
7. **Demand immediate results**: Although immediate results are always welcomed, there is a risk regarding expecting too much from the wrong people and activities: putting pressure in the wrong activities can jeopardize the lean transformation.
8. **As soon as you have momentum, expand your scope**: As soon as results of lean application and the news are spread across departments and functions, the lean champion needs to take the opportunities to use the lean techniques to reveal more problems and offer solutions to remove waste and streamline the processes.

### Uncertainty to deliver lean results

Womack and Jones (2003) proposed the action plan in a manufacture context, yet empirical and anecdotal studies have challenged the universality of lean tools. For example, The Manufacturer Magazine (2011) reported that only 5 % of lean project delivered the expected results in 2010. Many successful organizations are still successful without submitting to the lean thinking. For example, companies that have win the Shingo prize, which is awarded to companies that successfully implement management practices such as Six Sigma and Total

Quality Management (TQM), reported a gross profit and revenue growth weaker or similar later than their peers without that prise after three years (McCullough, 2011).

The factors that lead to lean failures have been under-researched (Cooney, 2002; Cox and Chicksand, 2005). We reviewed the literature on sciencedirect and emerald from 1993-2015 and classified lean failure factors under three categories: (i) Leadership, (ii) Business Culture and People Issues, and (iii) Action Plan Customisation**.**

**Leadership**

Cudney and Elrod (2011) proposed that a number of factors contribute to lean failures: (1) Short term commitment, (2) Lack of focus on a specific issue, (3) Poor Planning (4) Poor employee involvement (5) Ineffective training method (6) Poor understanding from top managers. Kubiak (2011) reviewed the lean Six Sigma initiative and supporting processes of a large multinational organization and found that proper planning suffered because this organization's leadership desired fast results. Achanga et al. (2006) studied ten SMEs that had recently implemented lean projects and found that, despite the scepticism within SMEs about the benefits of lean thinking to their business, the critical factors of lean success and failure were: leadership, management, and strategic vision. Sarkar (2011) reported eight factors that lead to failure of Six Sigma or lean production: (a) not having a mindshare of leadership (b) not working on right business priorities (c) not having a larger roadmap in place (d) not being a methodology agnostic (e) not having the right number of change agents (f) not able to coach the top management (g) not focusing on values necessary for creating continuous improvement culture (h) not having the right organisational culture.

McManus (2008) argued that Six Sigma and Quality programs in general fail because business leaders fail to support them properly with trained mentors, team members and funding. Seddon and Caulkin (2007) argued that leaders and managers often make the mistake of supposing that lean tools and techniques are adequate to deliver a profound shift in

lean thinking and business culture. However, leaders need to first unlearn and then relearn in order to initiate a radical redesign and (as a consequence) cultural change.

**Business Culture and People Issues**

Bamber and Dale (2000) studied the application of lean production methods to a traditional aerospace manufacturing organization. Despite early achievements with the help of external lean consultants, the company couldn't cultivate a lean culture since for at least two decades people have been poorly managed in the company. Therefore, there was no commitment to lean production, and as soon as consultants left, interest in the lean production evaporated, inhibiting improvements within the factory as well as preventing the spread of lean production methods to suppliers. Chen and Meng (2010) reported that since the 1990s, many enterprises in Chinese Mainland have deployed lean production, yet many of them failed to realize their original targets due to the following reasons: (a) companies failed to recognise the strategic importance of lean thinking and focused too much on lean tools (b) companies were eager in quick results and abandoned lean process with the first failure (c) companies attempted to imitate and copy success practices without adopting them to their own business culture and (d) knowledge of lean tools was superficial without analytical skills to pinpoint problems. The authors suggested that only with a cultural change lean thinking can be beneficial to Chinese companies.

Carter et al. (2011) reported a lean implementation failure in public sector (HM Revenues and Customs - HMRC) mainly due to people issues. Emiliani (2011) commented on this study and attributed failure to the managers and consultants promoting lean management as a zero-sum outcome that benefit the company at the expense of workers. Emiliani further suggested that, to adopt lean in HMRC or other civil service, senior management needs to be prepared to learn something completely new, which is a prerequisite for the correct lean practice.

**Lean Action Plan Customisation**

Various studies have stretched the importance of customising lean techniques to the social and technical specificities of the adopting organization. For example, Turesky and Connell (2010) reported a lean manufacturing change initiative at a Northern New England company which failed to produce sustained results and proposed a four-stage process of a lean project: foundation, preparation, implementation and sustainability for continuous improvements.

Cox and Chicksand (2005) presented an unsuccessful implementation of lean principles in the red meat industry. The decision to adopt lean principles came as a response to the observed loss of competitiveness of the industry. Although leaning the operations was cost-effective, it was not feasible to change the business partnerships and supply chain culture which was based on short term, adversarial relationships. Another study on the red meat industry demonstrated that lean principles were beneficial within one specific process of the chain (Simons and Zokaei, 2005). The study attributed a correlation between "advanced lean cutting rooms" and a productivity increase of 25 % compared to the traditional cutting rooms.

Operational issues can be a barrier for lean implementation (Lyons et al., 2013). Lean tools seem more suitable for high volume sales with predictable demand patterns and supply certainty (Pullan et al., 2013). Without strong supply chain governance, there is a lack of leadership in initiating and implementing the necessary changes across the supply chain. Supply chain governance can be achieved by different types of collaborations such as strategic alliances and collaborations across the supply chain (Kerber and Dreckshage, 2011).

Despite the effectiveness of lean tools to reduce waste, a number of failed lean projects indicate that the action plan initially proposed by Womack and Jones (2003) may have limitations and needs adaptation when applied to a different context other than manufacture industry. Literature review has revealed only but a few recurring factors that have may lead to lean failure, including: Leadership, Business Culture and People Issues, and

Action Plan Customisation. The lack of a lean action plan especially for SMEs creates a need for action research and reflecting learning from lean implications in practice.

**Global Tea Value Chains and the UK**

Drunk by nearly nine in ten Britons, tea is more a household staple rather than a discretionary item with a mature yet diverse market. Retail value sales of tea lifted to £655 million in 2011, a 22% increase over the last 5 years. Value and market shares of in home tea retail sales were in 2011, respectively: Ordinary Bags (£463m, 71%), Fruit & Herbal Bags (£54m, 8%), Speciality Bags (£52m, 8%), Decaffeinated Bags (£36m, 6%), Green Bags (£22m, 3%), Loose (£16m, 2%), Instant (£8m, 1%), and Organic Bags (£4m, 1%). Being omnipresent in every British home, the main channel of distribution is through supermarkets (88% of the volume). 63% of the market share is found between four brand leaders (Unilever, Tetley, Twinning, and Typhoo) focusing on every day range of packaged black tea. The increasing public concern about health is slowly shifting the demand on alternatives such as green and herbal teas.

Tea grows in tropical and subtropical countries, such as India, China, Sri Lanka, Indonesia, and Kenya. Though tea companies have to source from the same main regions, sourcing from remote regions create waste in supply chains, and they need to adjust their sourcing strategy depending on factors such as the type of tea, operational capacity, price fluctuations, and volume. Tea market is mature therefore uncertainty in production due to demand fluctuations is lower. Concentration in supply allows for economies of scale and operational efficiency to outbalance losses from waste. Therefore, to survive and prosper, small and medium food companies need to remove waste from their supply chains, particularly upstream the supply chain. Currently, the world tea market is high concentrated: 90% of western trade is concentrated in seven multinationals companies; 85% of world

production is sold by multinationals. In UK, the tea market is high concentrated with CR4 steadily over 75%. Even at tea auctions in countries like India and Sri Lanka, large brokers prevail; i.e. the largest tea broker in India handles over 155 million kg of tea a year, which is about one third of all tea auctioned in India.

## Methodology

### The Research Design

Case study research was selected for an in-depth inquiry of lean adoption by a UK-based tea company with operations overseas. Case study research attempts to explore, describe, or explain events as they actually happened (Yin, 1994). Action research is an iterative process involving researchers and practitioners acting together on a particular cycle of activities, including problem diagnosis, action intervention, and reflective learning (Yamnill and McLean, 2010). Holter and Schwartz-Barcott (1993) described action research as an inquiry in the context of focused efforts to improve the quality of an organization and its performance. Action research involves the research making active contributions to the case company while undertaking the research. There is consensus there is a gap in the academic literature on how to produce sound research designs when conducting case research (Hamel et al., 1993; Morgan and Morgan, 2008; Yin, 1994). Zuber-Skerrit (1995) proposed a four-step process in dong action research: (1) planning, which involves reconnaissance; (2) taking actions; (3) observing processes and outcomes and collecting data at both individual and group levels; and (4) reflective learning.

### Validity, Reliability and Sources of Evidence

In order to increase the validity and reliability of the research design, a number of different types of evidence can be utilised, such as documents, archival records, interviews, direct

observation, participant observation, and physical artefacts (Thorpe, 2012; Yin, 1994). Documents could be letters, memoranda, agendas, study reports, or any items that could count as evidence. Documents are stable and unobtrusive source of evidence, yet access to critical or sensitive information may be blocked. This study used various reports in order to collect evidence about value, value streams, operations management, and performance objectives. Archival records could be useful since they include service records, maps, charts, catalogues of names, survey data, and even personal records such as diaries. However, they lay on the same limited access with documents. This study utilised archival data in order to assist in developing the value stream mappings. Direct observations can examine formal or casual activities, but the reliability of the observation is the main concern. In this case study, walk-in the warehouses, observation of operations in practice were directly observed during on-site visits. Interviews are the main source of evidence in case research (Marshall and Rossman, 2010), therefore, in this study, the primary source of information was the open-ended, semi-structured interviews with key decision-makers. In action research, interviews take the form of informal and formal discussions. Therefore, the interviews with decision-makers provided evidence which were triangulated with data and information collected from other sources such as reports and direct observations, which increases the validity of the research design.

**The Case Company**

The case company, named as AlphaTea, is an UK-based, small-to-medium sized company with less than 250 employees operating in more than five different countries. Functions such as sourcing, new packaging design and product manufacturing are traditionally kept in house. The company has a strong annual growth of about 30%, with a wide range of products including black, green, white teas and herbal infusions in more than 10 different packaging

formats. The company finds easier to sell its products to specialist food shops, luxurious hotels and restaurants. The company recently built a new plant in India. This decision was motivated by the need to guarantee the best quality of tea leaves by reducing the transport time between the tea growing regions and the manufacturing site equipped with a modern storage and climate control technology.

**Findings**

AlphaTea implemented lean in three stages: (a) Preparing for lean (b) Diagnosis and (c) Lean Operations and Control. The first stage contained all the necessary steps to build up a team and influence the culture including an initial attempt to apply lean tools. The second stage was the diagnosis of the current situation evaluating the results of the attempt to apply lean. The third stage was the actual lean operations and control. Figure 1 presents the lean action plan applied by AlphaTea.

**Preparing for lean**

The steps that AlphaTea took prior the lean implementation were the following: (1) Decision to go Lean (2) Forecasting Customer Demand (3) Visit to the Factory (4) Seek Management Support.

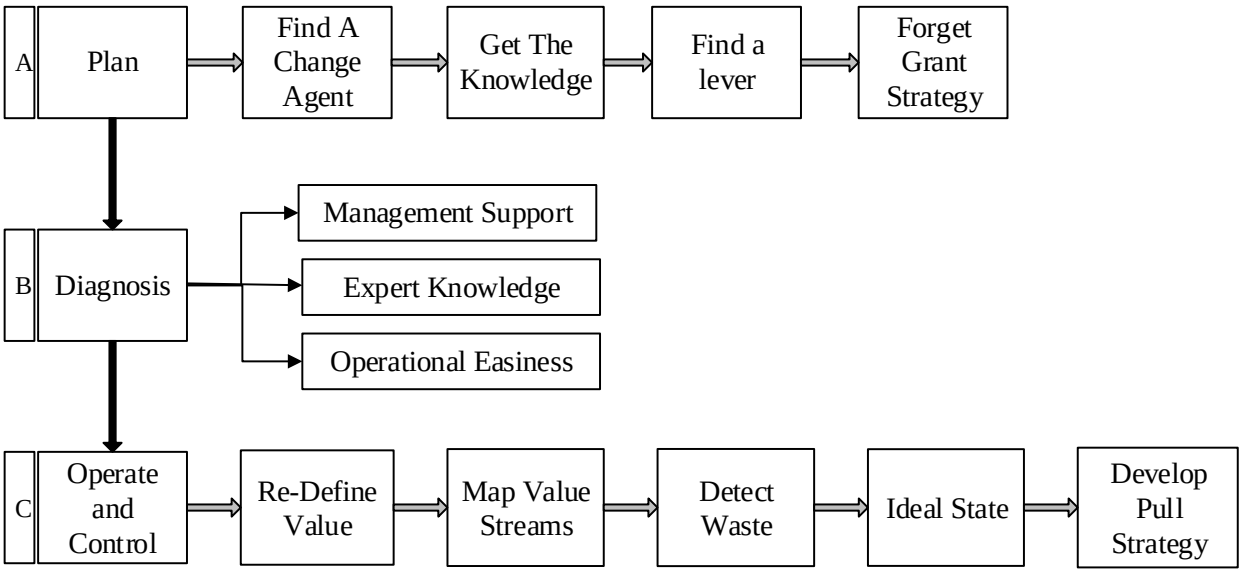

**Figure 1 Lean Action Plan**

Find a Change Agent

The strong growth in demand during the last two years created problems of capacity shortage in AlphaTea. The first and prompt reaction was to employ more personnel to handle the increasing demand, yet a rushed recruitment did not have the expected results and a lack of skilled employees triggered recurrent errors, defects and quality issues. In one instance, quality control procedures were not kept by the book and contaminated tea was spotted at the very last stage of production resulting in significant loss and management frustration. This problematic situation was seen as an opportunity for change by imposing new ways of operating with less waste.

The supply chain director of AlphaTea turned to lean principles to streamline processes. He pointed out that "I knew I was taking on a real challenge as our Chairman and COO knew peanut about TPS, Le*an and continuous improvement".* The main argument put forward was the opportunity to reduce the inventory by half within a year and an increased control of production schedule. The initial plan estimated about £500k savings in inventory reduction and increased product availability.

Get the Practical Knowledge

The project kicked off by involving the tea buyers in order to get their input on issues such as sourcing lead time and delivery window. Not much improvement was obtained due to the lack of control over the process and suppliers production schedule that could see variations of up to 6 months. Therefore, the use of buffers appeared to be unavoidable.

## Find a Lever - Visit to the Factory to seize a crisis

The next stage was a trip to India to meet the factory team and explain the requirements of the lean principles. The buying process had huge variations that would affect the factory's ability to maintain a levelled production. Other constraints were the lack of collaboration culture between the company and its suppliers, the sudden Indian custom import rules amendments that could delay supply by up to month and last but not least the distances applicable between the factory, its suppliers and its markets.

The factory team immediately reacted with disbelief. The time required for the changeovers alone did not allow for such schedule. The changeover lead time could be reduced if the production sequence was about flavourings-free products. However, although this solution sounded logical it did not fit the actual demand pattern.

## Forget grand strategy

Once back in the UK, top management was debriefed and support was obtained despite the resistance to change from factory managers. Daily online conferences were scheduled with factory managers to identify the most realistic sequence of production. The greatest challenge was with the machine as no one in the team had the skills to dismantle and re-design some parts. The cost associated with the assistance of a dedicated engineer from the company selling these machines was so high that this option was quickly dismissed. The management team decided to go ahead and put emphasis on streamlining factory operations.

Improvements were based on calculating the current takt time of the operations, the number of operators needed as well as the number of kanban required.

- Takt Time = Working hours / day ÷ Demand /day
- Daily demand = Monthly demand ÷ Working days / month
- Number of operators needed = Operating Cycle time ÷ Takt time

- Number of Kanban required = Daily demand x (lead time + buffers) ÷ cases per pallet

The solution adopted was an improvement of the previous production system, which was a pure push system with large batches produced and shipped in a weekly basis. Therefore, the forecasted demand for the month was divided into weekly batches requirements. The new system was a daily schedule where the forecasted demand for a month was broken down into daily requirements quotas. Although this approach can be qualified as a mixed model of production, the use of batches remains strong. Each day was divided into production windows dedicated to one product only. Changeovers were intentionally kept to a minimum and were without doubt a very important factor influencing each day workload. Inventory did not decrease as no opportunity to do so could be identified. A recurrent issue linked to the Kanban was when all production kanbans were accompanying the output buffer stock or were simply damaged or lost. The flow of the production sequence was also frequently disrupted by productions dictated by best before date requirements, exportation requirements to avoid import duties and machine breakdown or maintenance. The supply chain was regularly disrupted by events such as port health inspections, transhipment delays, poor packaging quality, and shrinkages at destination ports due to thief. Any past attempt to alter the inventory policy was quickly punished by a major shortage and unhappy customers.

**Interim Lean Diagnosis**

The initial lean project faced many difficulties and it was quickly abandoned. The attempt to improve factory operations was also unsuccessful. The Alphatea company employed reflecting learning to learn by its own mistakes. Specifically, the Alphatea company conducted an interim lean diagnosis to identify problems from its inception until late discovery of problem in production line and revealed three problematic areas:

### Lack of top management support

Top management was never directly involved in the lean project, resulting in a limited project in scope and in scale. Lack of lean knowledge was a barrier to support and commit in lean changes, an attitude visible to the workforce.

### Lack of expert knowledge

AlphaTea company as a SME could appoint one lean change agent in a key position, yet knowledge about lean tools and techniques was lacking amongst most managers. As a result, focus remained on achieving immediate, quick results than long term planning and strategic lean thinking. AlphaTea attempted to overrun this lack of knowledge by focusing on kanban methodology. They also explored Single Minute Exchange of Dies (SMED) methodology, which aims at the elimination of wastes in the work environment that result from unorganized, unclean material, tools, machines, associated with setup/changeover processes (Shingo, 1985).

However, the attempt to get immediate results was not fruitful since lean success requires a series of successful and successive steps, one depending on the previous one, i.e. first define value, then identify value streams, then create flow and so on. Further, often the simultaneous implementation of several lean tools is required, which necessitates an advanced knowledge of lean tools (Bhasin and Burcher, 2006; Liker, 2004).

### Operational Easiness

Tea industry, like many food industries, is unique in having high and unpredictable supply variability due to weather conditions, seasonality, and international trade constraints. Further, demand is satisfied by recipes and in turn recipes are based on ingredients that have an uncertain supply-side. Therefore, recipes need to be flexible to adapt to the market

environment, yet changes in production lines are generally long and involve rigorous cleaning, and re-tuning that generate waste. For example, strong flavour products should be produced after weak flavours thus adding a constraint to the optimum production sequence to be adopted. Supply of ingredients depends on auctions with prices fluctuating unpredictably. Improving production operations while work-in-progress need long-term commitment to trade-off any operational difficulties during transition.

Another critical factor missing to AlphaTea was a crisis to trigger the change process. A crisis leaves little room for disagreement on a "new sense of purpose and team spirit in saving itself from oblivion" (Womack et al., 1990, p. 258) and motivates individuals to overcome what was perceived as impossible for years. The quality issues that triggered the lean action plan were the missed opportunity to act as a lever to pursue lean changes, since they were the crisis that a lean manager would ask for. **Error! Reference source not found.**

**Table 2 Interim Diagnosis of Lean Action Plan**

| **Stage** | **Action Taken** |
|---|---|
| **Find a lean change agent** | Change agent was an existing manager. The company had to employee one or more lean consultants experienced to bring lean knowledge and best practices. |
| **Get the knowledge** | This step was actually skipped as lean knowledge was not shared with other managers and employees, resulting in misunderstanding and resistance to change. |
| **Find a lever by seizing a crisis or creating one** | The lean project begun as operations could not match demand, which was not a crisis and/or the situation was not communicated to employees to motivate them to change.<br><br>On the contrary, before embarking in the lean journey, top management need to clarify to employees that the necessity to change and implement lean thinking. Reducing waste and offering better services should be the rational and motivation to improve activities and eliminate non-value added activities. |
| **Forget grand strategy for the** | AlphaTea seemingly did forget grand strategy and focused on |

| | |
|---|---|
| **moment** | solving operation issues and streamlining the processes however the nature of the product requires a strategic and long-term commitment since production lines needs tuning that would disturb production flows. |

**Operation and Control**

Based on the lessons learnt from the initial attempt to implement lean techniques and the interim diagnosis, the next stage, lean implementation and control, was developed. AlphaTea needs to adopt the key concepts of lean thinking: value, value stream, and pull strategy. Therefore, the lean implementation and control contains the following steps: (1) Re-Define Value, (2) Map Value Streams, (3) Detect Waste across the Value Stream, (4) Develop an Ideal State of Production Operations, and (5) Control the Lean Operations.

Re-Define Value

Value comes first in lean thinking. This company needs to redefine what is value based on pragmatic demand forecasting and then rationalise the product range to satisfy demand better.

**Demand Forecasting:** The supply chain can make good use of sales forecasts on a 15 months period for each SKUs for every local market. An elementary analysis of previous demand forecasts showed a great variability and deviations often were as high as 200% of the initial plans. For example, sales teams often organized promotion events without informing the operations which resulted in draining out stocks and created inventory backlogs, and frustration among the operation teams. By integrating the sales with operations and fostering open communication channels, the sales function is no longer working in isolation and reliable demand information is quickly passed to operations.

**Product Range Rationalization:** Having sales and operations working in silos, another problem gradually became critical: slow moving products were never deleted from the

product range. Research & Development (R&D) added new products to the product range in a continuous basis creating a chaotic offer range of products with little or no appeal to consumers. A commitment to slow-moving products did not justify the cost of sourcing and manufacturing creating a huge waste across the supply chain. Re-defining value was necessary to remove slow-moving products that add little or no value. AlphaTea focused on value-added products thus creating a strong basis for rationalising the product range and in turn for optimizing the value streaming.

### Map Value Streams

Having re-defining value based on customer demands, the next step is to create a value stream to support and offer value to customers. In order to do so, the company needs to map the existing value streams and identify problematic areas or activities that add little or no value. There is a variety of tools to map the Value stream such as Process activity mapping, Supply chain response matrix, Production variety funnel, Quality filter mapping, Demand amplification mapping, Decision point analysis, and Physical structure (Hines and Rich, 1997). The decision which tools to use is based on factors like: availability of information, knowledge of lean techniques, and time constraints, with the Process activity mapping being the most commonly used.

The Process activity mapping breaks down the process to the smallest detail. Each activity within a process is plotted onto a spreadsheet. Each activity is described by its characteristics, resulting in a large and clear picture of the entire process. Process activity mapping offers an aerial view of the value-added processes and helps managers to identify processes that add little or no value (Wood, 2004). Figure 2 depicts the tea value stream and the process activities of AlphaTea.

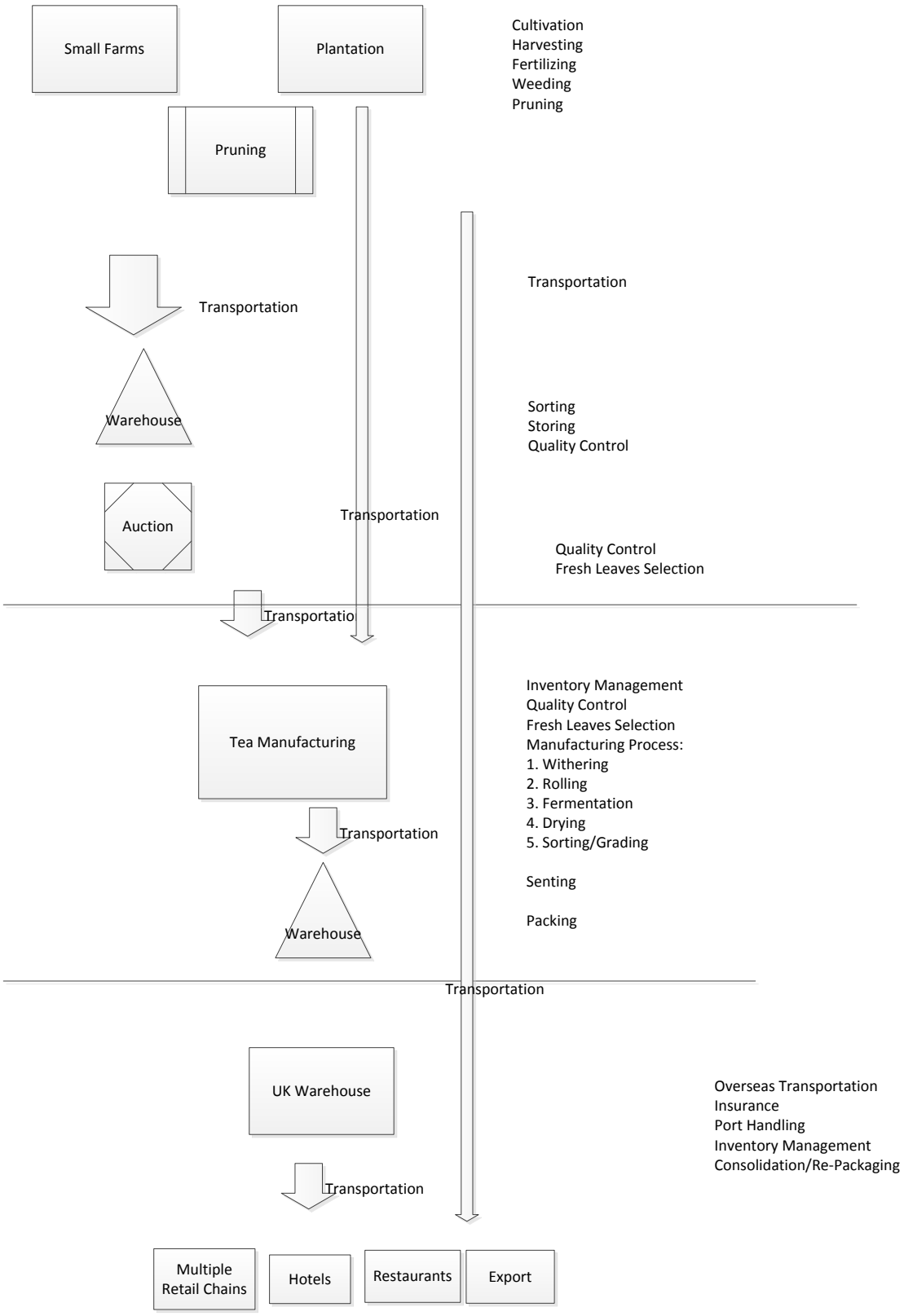


**Figure 2 Tea Value Stream & Process Activities**

Detect Waste across the Value Stream

The Value stream map makes waste visible to detect across the tea value chain. Table 3 presents the lead time analysis over one year. Sourcing takes places from March to August thus packaging needs to be sourced before team arrives at factory door that is from January to March. The economics of shipping dictates the use of forty foot containers loaded with 20 non-stackable pallets of finished products to be shipped to the UK. Average lead time from factory door in India to UK is 40 days. Out of a cumulative 28 months of processes, only 5 months (17%) can be considered as value adding. When shipping of finished products actually takes place, they have lost a minimum of 5 months or 21 % of their required shelve life (24 months).

**Table 3 Yearly Lead Time Analysis**

| | Jan | Feb | Mar | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sourcing** | | | X | X | X | X | X | | | | | 5m |
| **Packaging Material Purchase** | X | X | X | | | | | | | | | 3m |
| **Manufacturing** | | | | | | X | X | X | X | X | | 1w |
| **Storage** | X | X | | | | X | X | X | X | X | X | 6m |
| **Ship UK** | | | | | | | | | X | X | X | 40d |
| **Storage** | | | | | | | | | X | X | X | 2m |
| **Exporting** | | | | | | | | | | | | 70d±15d |
| **Workload/Month** | 2 | 2 | 3 | 1 | 1 | 3 | 3 | 2 | 4 | 4 | 3 | 28 |
| **Shelve Life** | | | | | | | | | | | | 24m |
| **Actual Shelve Life** | | | | | | | | | | | | 12m-17m |

Note: d=days, w=weeks, m=months

Develop an Ideal State of Production and Supply Chain Operations

AlphaTea achieved a certain degree of leanness by identifying the sequence of product would deliver the better runs and allow for changeover with minimum contamination risk and

wastage. This approach is called the Fixed Sequence Variable Volume (FSVV). A fixed sequence implies that each product actually waits for its turn. In doing so, it considers the whole production cycle instead of focusing on individual products and decreases the waste resulting from random and impractical changeovers (Floyd, 2010). FSVV organizes the production schedule to address the bulk of the operations into a fixed, schedule system that will enable the whole product range to be produced faster and at lower cost. This scheduled, optimized production system delivers extra capacity to respond to non-routine requirement from the market.

With a traditional system and one tea packing machine to produce a range of 200 products the AlphaTea would have to deal with a virtually infinite amount of changeovers. With FSVV, it would have to deal with only 200 different changeovers possibilities. The heart of the system is the fixed sequence that reduce to the strict minimum the loss caused by changeovers and extra stock production. Changeovers and extra stock can therefore be seen as "Type One Muda", which is waste that can be reduced but not eliminated. The ideal state was calculated for a production of A, B, C with a respective demand of 2000, 800 and 600 units per month (Figure 3).

Develop a Pull Strategy to Control the Lean Operations

The next step after detecting waste and finding an ideal, waste-less state of operations is to create a pull strategy so value is pulled from customers and not pushed from operations to markets. This requires controlling the synchronisation of value stream particularly with domestic demand and overseas factory as well as controlling the quality and safety processes.

**Value Stream Synchronization**

The AlphaTea factory in India has to deal with specific issues linked to cash flow requirement, customs regulations, and material quality. The cash flow requirement was a

consequence of the bank loan contracted to build and develop the factory. In order to generate cash to pay back the loan, the factory manager often was forced to push finished products out in order to issue invoices and thus trigger a payment. Changing from a push to pull strategy required dealing with cash flows in India factory. In doing so, the factory shipped products only when was required to do so, which resulted in over 30% reduction in inventory since with the push strategy local market could accumulate a year's worth inventory.

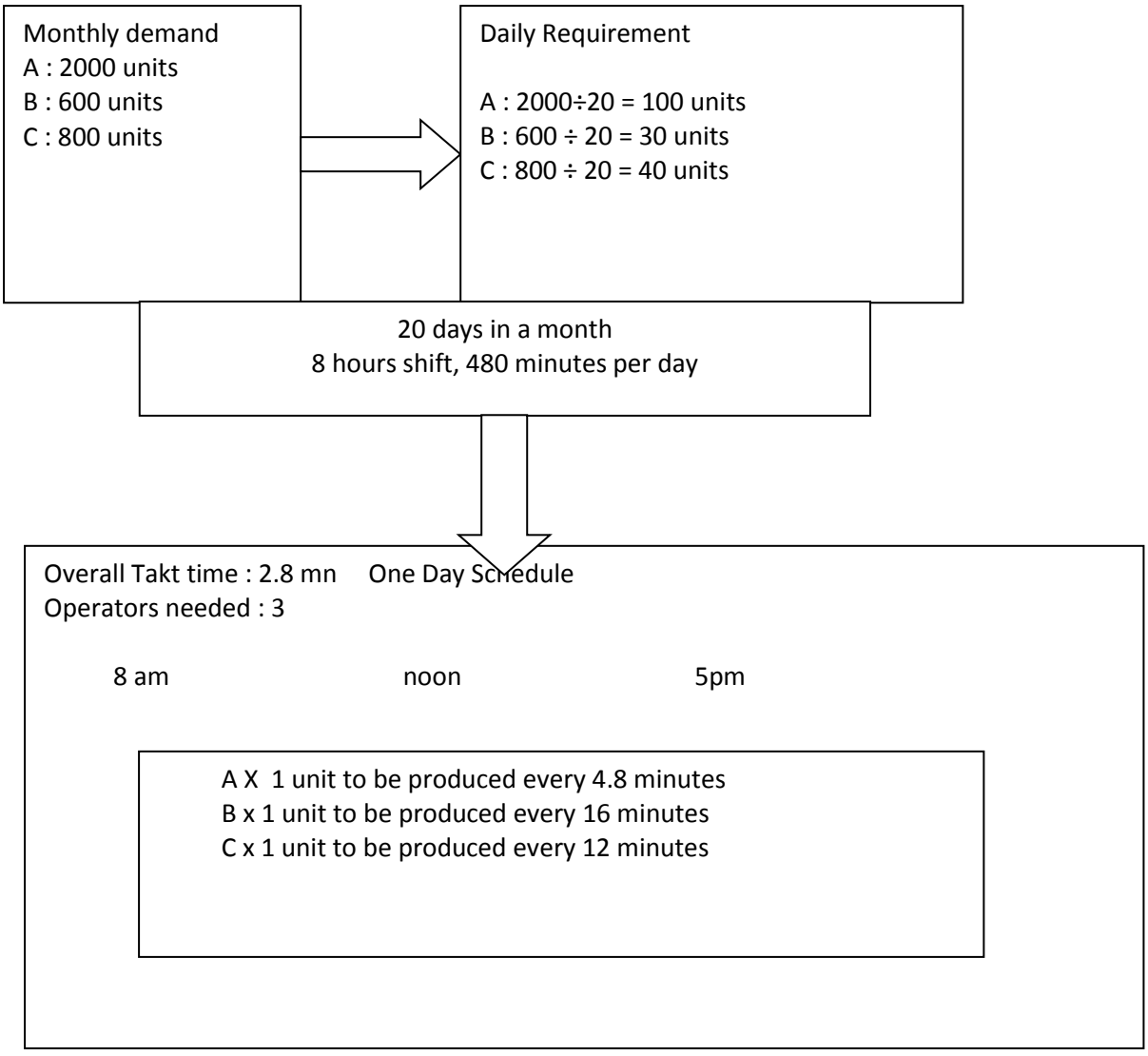

**Figure 3 Ideal State of Internal Operations**

Customs regulations can be very strict with food and agricultural products and in order to avoid paying import duties on foreign packaging materials and Chinese grown teas the company entered in an "advanced license agreement" that would suspend all payment as long as the imported material was re-exported within six month. As a result, products were shipped regardless of the demand being materialized or not. By synchronizing demand forecasts for the next 2 years, advanced license agreement could be reflect real demand patterns.

**Quality Management**

The late discovery of quality issues can add waste and frustration. Such late discoveries came with a painful cost as finished products were either destroyed or put in quarantine. Quality issues often happened with newly introduced suppliers. Issues could be anything from, but not limited to, unaesthetic overwrapping of the tea cartons, transpiration of the flavouring oils into the tea bag paper thus affecting the presentation of the product, foreign elements found in the tea, defective heat sealing of the catering pouches, high level of pesticides and other chemical forcing the destruction of an entire season worth of purchase, unexplained variation of the tea taste compared to the pre purchase samples. The development of strict criteria in selecting new suppliers and developing existing ones resulted in less quality issues and a smooth flow of value.

Continuous improvement is significant in lean thinking that seeks for perfection. Therefore, pull strategy rather than being the end of the lean process should trigger perfection seeking by re-defining value and challenging existing processes until waste has been eliminated permanently.

## Discussion

The tea industry is a customer-centric business, thus it could improve customer satisfaction by removing waste and defects from the products and services offered to customers (Levy, 1997). Particularly, in countries like in UK where nine out of ten people consume tea frequently, value needs to reflect consumer preferences. The adage that "no two customers are the same" is based on the assumption that every customer defines value in a unique way. Therefore, tea and food companies need tools and techniques for managing individual value streams in an effective and efficient way.

This study examined the adoption and implementation of lean tools in food supply chains. Removing waste from the food industry has the potential in huge cost savings, and increased value added. Despite the fact that 99% of the food companies in EU are SMEs, they generate only 45% of the value added. Lean tools have been successfully adopted in manufacturing sectors, yet there is a high percentage of failures and a lack of a lean paradigm of applying lean thinking in SMEs.

This study developed a lean action plan by adopting the Womach and Jones (2005) action plan based the action research findings. The proposed lean action plan contains three stages: (a) Planning for lean (b) Interim lean diagnosis and (c) Lean operations and control. Womack and Jones (2003, pp. 247–255) proposed a lean action which includes the following steps: (1) Find a lean change agent (2) Get the knowledge (3) Find a lever by seizing a crisis or creating one (4) Forget grand strategy for the moment (5) Map your value streams (6) Begin as soon as possible with an important and visible activity (7) Demand immediate results (8) As soon as you have momentum, expand your scope. Therefore, the lean planning stage includes the first four steps of Womack and Jones (2003) lean action plan (Find a lean change agent, Get the knowledge, Find a lever, and suspend grand strategy). However, research findings indicate that SMEs after planning for lean need to include an interim

diagnosis stage in order to assess their situation before implementing lean tools. Specifically, evidence on lean implementations have reported failures in managing the lean process due to factors such as: lack of leadership to lean (Achanga et al., 2006; Cudney and Elrod, 2011; Kubiak, 2011; Sarkar, 2011; Seddon and Caulkin, 2007), resistance to change from middle managers and failure to cultivate a lean business culture (Bamber and Dale, 2000; Carter et al., 2011; Chen and Meng, 2010; Emiliani, 2011), and lack of tools to customise the action plan to the specific needs of the adopting company (Cox and Chicksand, 2005; Turesky and Connell, 2010; Kerber and Dreckshage, 2011; Simons and Zokaei, 2005). AlphaTea attempted to follow the action plan that Womack and Jones (2003) proposed. Therefore, during lean interim diagnosis, companies need to address three barriers: (i) top management support; (ii) knowledge and (iii) Operational Easiness. Then, companies can move on to the actual implementation of lean operations and use specific tools and techniques to control these operations. They are: (a) Re-Define Value (b) Map Process Activities & Value Streams (c) Detect Waste across the Value Stream (d) Develop an Ideal State of Production & Supply Chain Operations, and (e) Control lean operations.

Using reflective learning, the Interim lean diagnosis is a learning experience that increases the organisational lean knowledge and helps companies avoid failures due to lack of top management support, lean knowledge, or operational easiness. Previous studies had also pointed out the need for organisational learning. For example, Wan and Chen (2009) suggested lean assessment to increase lean knowledge. The proposed lean action plan embeds organisational learning in a systematic way. Organisation learning takes place through a phased process of information acquisition, information distribution, information interpretation and use, knowledge transmission and storage (Hines et al., 2004). The lean action plan corresponds to the phased process of organisational learning, since during Planning for lean phase, companies acquire and distribute information about lean tools. Then,

during Interim lean diagnosis companies interpret information based on their own experience and in this way they acquire lean knowledge. Finally, during Lean operations and control phase, they use the lean information and knowledge in order to improve business operations and reduce waste. Another contribution of the proposed action plan is that it increases the organisational easiness and lean customisation since companies adopt the lean tool and technique which is more appropriate for their needs. Having acquired the required knowledge, companies can customise the lean process and tools to the specific type of waste they need to reduce and to the value proposition according to their customers' needs, which is another way to avoid lean project failures (Cox and Chicksand, 2005). Finally, the design of the proposed action plan invites support from top management and necessitates leadership throughout the duration of the lean endeavour, including key stages such as Interim lean diagnosis, selection of lean tools, and Control of lean operations. Thus, involving leadership and getting top management support reduces the possibility of failure in lean project (Achanga et al., 2006; Kerber and Dreckshage, 2011).Lean thinking is a set of principles, philosophies, and business processes, thus a solitary application of lean tool cannot transform the business culture and make a company lean despite any temporal waste savings (Tsasis and Bruce-Barrett, 2008). Womack and Jones (1996a) proposed a five steps model which assumes that there are five consecutive sets of actions from value to perfection. Lean thinking is not an ideal state of a waste-free, perfect organisation, but rather a way how to evolve from current operations and value propositions to leaner states of business operations. The practical contribution of the proposed lean action plan is that it directs companies to the right path using diagnosis to learn and cultivate a lean culture that towards perfection. Furthermore, the proposed lean action plan is particularly helpful for SMEs that often lack the resources and knowledge how to implement lean tools. Lean thinking, being one of the most influential new paradigms in manufacturing, still lacks a widely accepted action plan on

how to select and apply lean tools and techniques in order to reduce waste and increase value for customers. A successful lean action plan can have a significant contribution to small and medium food companies. Like tea industry, concentration is high in food sectors and the majority of companies are SMEs that strive to offer value for money. Lean tools put value first and by eliminating waste reduce cost, a combination that can offer a sustainable competitive advantage. Leaning the food supply chains can have a significant impact on sustainability (Gustavsson et al., 2011). There is little guidance on how lean can be applied to SMEs and the findings of this study shed light in many aspects of the process: it offers a diagnosis and reflecting learning of a lean action plan that can help companies to drive change to the right, lean direction.

AlphaTea company benefited from the adoption of lean philosophy. First, it created a culture of learning and continuous improvement. Then, Interim diagnosis created a systematic way to evaluate and plan. Developing ideal states of operations and supply chain helped AlphaTea to remove waste from its operations. Using takt time and value stream mapping, changeovers reduced from an overtly infinite number to less than 200, paving the way for future reductions. Demand synchronisation further reduced lead times and inventory levels. Quality issues were dealt at earlier stages and losses and frustration were minimised.

The research contribution of this lean study is threefold. Firstly, it developed and tested a lean action plan adopted for small and medium companies. Secondly, it applied lean thinking in the food sector, extending the research scope into an area characterised with low productivity, low value added and high value wasted across the food supply chain. Further, it used a new methodology using action case research to gather, analyse and interpret qualitative evidence. Action research is suitable for examining the adoption and implementation of lean tools in food supply chains since the lean change cannot happen in an experimental basis and studying lean as it happens offers an unprecedented opportunity to

uncover and reflect of a real case. This study took advantage of the reflecting learning offered by the selected method to modify the lean action plan by adding the stage of interim diagnosis of lean process as it happened. Interim diagnosis allows SMEs to identify problematic areas and apply corrective measures into a customised action plan. For example, AlphaTea used the activity process map to identify waste, yet other companies may find useful to apply other lean techniques such as Quality filter mapping, Demand amplification mapping, Decision point analysis, and Physical structure.

**Limitations and Suggestions for Further Research**

This study was based on scarce literature about lean applications in the food industry (Bowen and Youngdahl, 1998). As a consequence, the findings and results from this study are limited to its assumptions (Courville and Hausman, 1979). The preferred method for researching ad-hoc situations is case research, in-depth interviewing, and participant observation. However, one limitation of the case study approach is the difficulty in drawing generalizations to every tea and food company. It was not possible to collect data to examine value stream mapping techniques like production funnel or quality filter, however value stream mapping can also be useful for food managers and further research is required.

Further research could compare lean techniques with other systems, such as the Kanban card system (Pegels, 1984) or other customized systems for tracking defaults and errors (Goddard, 1982).

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