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The Application of Lean Principles in the Fast Moving Consumer Goods (FMCG) Industry

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ABSTRACT: Proponents of Lean Manufacturing (*lean*) claim that the benefits of implementing this system are not restricted to the automotive industry where lean originated. On the other hand, opponents of *lean* argue against its claimed universality and stress that even within the automotive industry mass production still prevails. This research aimed at examining this claimed universality by investigating whether *lean* is applicable to the Fast Moving Consumer Goods (FMCG) Industry. The research was carried out via qualitative, multiple case-studies of three different Saudi Arabia FMCG operations including two confirmatory interviews, one with a US FMCG manufacturer and another with a UK manufacturer. Data was collected via semi-structured interviews with 22 participants.

The research concluded that the same types of waste identified by *lean* in the automotive industry are present in the FMCG industry, suggesting that *lean* could be implemented in FMCG operations. The study also identified the conditions required for successful implementation and consequently developed a conceptual framework for implementing lean in the FMCG industry.

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1. INTRODUCTION

In the 1980s it became apparent that the American auto industry which depended on mass production was losing to foreign competition. Consequently, a commission led by the Massachusetts Institute of Technology (MIT) was set up in 1986 to investigate the causes of the phenomenon (Duguay, Landry & Pasin, 1997; Womcak & Jones, 1996). The results of the study were published in The Machine That Changed the World (Womack, Jones & Roos, 1990, pp. 9-282), a book which documented the superior performance of Japanese Auto manufacturers due to their implementation of lean manufacturing (Womack & Jones, 1996). Womack & Jones (2003, p. 15) argue that Lean Manufacturing (lean) is the "antidote" to muda, the Japanese word for waste. In a way, lean is similar to mass production in the sense that it "creates outputs using less of every input" (Lehtinnen & Torkko, 2005, p. 58). However, the difference between the two lies in lean's ability to offer more variety to customers (Womack, Jones & Roos, 1990, pp. 11-12).

Since the early 1990s, lean has been successfully implemented across several industries, including appliance manufacturing, the aerospace industry, healthcare and fast food companies (Moyano-Fuentes & Sacristan-Diaz, 2012). However, notwithstanding, there is a fierce debate in the *lean* literature on the universality of *lean*, i.e. its applicability across all types of industries, including non-manufacturing (or service) industries. Whereas some authors like James-Moore & Gibbons (1997) agree with the claim that *lean* is a universal model applicable to any industry, others like Cooney (2002) disagree.

The literature reveals that not much attention has been given to the application of *lean* principles in the Fast Moving Consumer Goods industries (FMCG). The few articles on *lean* in FMCG appear to focus on either the supplier's end of the supply chain (for example, Found & Rich, 2007), or the retailer's end of the supply chain (for example, Francis, 2004), but not the operations of the FMCG manufacturing. This gap is clearly evident in the study carried out by Bhamu & Sangwan (2014) in which they reviewed 209 *lean* related literature published between 1988 and 2012. Of these, only one research (0.47%) was related to FMCG industry, and even this single research was related to the retail side of the business rather than the manufacturing side. This research therefore contributes to filling this gap by investigating the applicability of *lean* in FMCG manufacturing and warehousing operations through case studies of three FMCG manufacturers located in Saudi Arabia, including two confirmatory interviews, one with a US FMCG manufacturer and another with a UK manufacturer.

Although *lean* is a well-established system that has been implemented for decades across several industries, it does not appear to have an agreed upon approach for implementation. Various initiatives in the *lean* literature have proposed implementation approaches, which could be grouped into five categories: conceptual frameworks, implementation frameworks, roadmaps, descriptive and assessment checklist (Mustafa, Dumrak & Sultan, 2013). This research proposes a conceptual framework specifically designed for lean implementation in the FMCG manufacturing industry.

The research question is: How can *lean* principles be applied in the FMCG manufacturing and warehousing operations? This research question is addressed through the following research objectives:

- To determine whether *lean* principles can be applied in FMCG operations.
- To examine the conditions under which *lean* principles can be applied in FMCG operations.
- To identify which *lean* tools and techniques can be applied in FMCG operations.
- To determine the potential benefits and drawbacks of implementing *lean* in FMCG operations.

We begin our inquiry by a review of *lean* literature on what *lean* is, the universality of *lean* and a quick review of *lean* tools and techniques. Next, we describe the research methodology. This is followed by a review of the research results. We then analyze and discuss the results and propose a conceptual framework for implementing *lean* in the FMCG industry. Through this analysis, we contribute to the *lean* literature by covering the gap which we found in the literature related to implementing *lean* in the FMCG industry, and on the basis of our study's outcome that lean is applicable in FMCG manufacturing and warehousing operations, also support the view that *lean* is a universal system.

2. LITERATURE REVIEW

2.1 The meaning of lean

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The Machine That Changed the World is a book about the practices of the Japanese auto industry in general, and the Toyota Production System (TPS) in particular. *Lean* is the western name given to TPS. A clear-cut definition of *lean* is neither provided in *The Machine That Changed the World* (Womack, Jones & Roos, 1990, pp. 47-69) nor in the follow-up book, *Lean Thinking* (Womack & Jones, 2003, pp. 9-98). What is provided, however, are processes, tools and techniques to "banish waste and create wealth" (Womack & Jones, 2003, pp. 9-98) for any organisation.

Muda is the Japanese terminology for 'waste' (Womack & Jones, 2003, p. 15), and can be defined as "any human activity that absorbs resources but creates no value" (Wood, 2004, p. 8). Value, on the other hand, is the opposite of waste and is created as wasteful activities are reduced, or where additional features or services are added and are perceived to be valuable by the customer (Hines, Holweg & Rich, 2004). Taiichi Ohno, the Toyota executive who masterminded TPS identified seven types of waste (Womack & Jones, 2003, p. 15). Table 1 summarizes these wastes.

Table 1 - The Seven Types of Waste

2.2

Type of Waste	Definition	References
Overproduction	Producing goods without having customer orders, which results in overstaffing and higher costs of storage and inventory. This is the "most serious" of the seven types of waste as it obstructs the smooth flow of product or information and inhibits quality and productivity.	Liker (2004), p. 28, Hines & Rich (1997)
Waiting	Shop floor workers who sit idle either due to wrong workload balancing, just waiting for the next processing step, or because of out of stock of raw materials	Liker (2004), p. 28
Unnecessary Transport	The physical transportation of raw materials, finished goods or work-in-process (WIP). In addition to wasting time, this type of *muda* can also result in damage or deterioration of quality.	Liker (2004), p. 28, Hines & Rich (1997)
Over-processing	Performing unnecessary processing due to poor product or process design. Over-processing results in further muda in the form of defects, unnecessary movement and poor communication.	Liker (2004), p. 29, Hines & Rich (1997)
Excess Inventory	Inventory of raw materials, WIP or finished goods is a common way to hide problems (due to poor performance of suppliers or machines) and results in a significant increase in storage & transportation costs.	Liker (2004), p. 29, Hines & Rich (1997)
Unnecessary Movement	Any avoidable movement employees perform during their work which leads to poor productivity and possibly quality issues.	Liker (2004), p. 29, Hines & Rich (1997)
Defect	The production of defective goods. In the TPS, each defect is seen as an opportunity for improvement rather than a problem.	Liker (2004), p. 29, Hines & Rich (1997)

2.2 The universality of lean

Ohno (1988, p. 9), the creator of TPS, claims that the concepts of TPS, on which *lean* is based, "will work for any type of business." *Lean Thinking* (Womack & Jones, 2003, pp. 102-245), the follow up book to *The Machine That Changed the World*, is primarily a book about success stories of *lean* implementations across various industries in various countries. However, there are critics of *lean* who debate this claimed universality, like Papahristodoulou (1994) who is of the view that *The Machine That Changed the World* is "a book that promises too much and proves too little." More recently, Howison (2009) has also claimed that:

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> *"managerial fervour that described lean production as a lifeline for the US auto industry has subsided in the latest wave of bailouts and loans for General Motors and Chrysler. In spite of the adoption of lean production and the latest technological manufacturing equipment, 825 jobs were cut at Toledo's North Jeep Assembly Plant in October of 2008."*

To such arguments and claims, the proponents of *lean* respond that whilst many companies claim that they are *lean*, they are in fact only implementing a set of *lean tools* without considering *lean* as a complete system (Liker, 2004, p. 10), for example, although just-in-time deliveries are claimed as being practiced, they are simply a relocation of inventories from a company to its next upstream supplier (Womack & Jones, 1996). The studies by Hines, Holweg & Rich (2004), Liker (2004), Spear & Bowen (1999) and Towill (2007) argue that *lean* is not only a set of best practice tools that can be implemented to achieve results but rather a complete model, a philosophy that requires a change in culture in parallel with the change of work processes and procedures. According to Liker (2004, p. 10), this explains why many companies think they are *lean*, but are not in reality, because they do not implement the complete model, and this also explains why many *lean* implementations fail. It is, therefore, not surprising that Childerhouse & Towill (2004) found that the overall success rate of *lean* is as low as 50%.

2.3 Lean tools and techniques

With regard to the operational aspect of *lean* tools and techniques, Ohno (1988, pp. 4-15) stated that the two pillars of TPS are Just-In-Time (JIT) and Autonomation (or automation with a human touch), and these pillars are supported by teamwork and production levelling. Table 2 categorises the various *lean* tools and techniques into five groups

Table 2 - Lean tools

Category	Tool	Description	References
Just-In-Time (JIT) Tools	*Kanban*	Only produce to order, no more and no less, in order to create flow	Jones, Hines & Rich (1997)
	Andon	Giving operators the power to stop the operation when an error is detected	Jones, Hines & Rich (1997)
Autonomation tools	*Jidoka*	This means automated stop system and is a function of machine design to allow machine to stop when an abnormal situation arises	Ohno, T. (1988)
Production levelling tools	*Heijunka*	Production levelling by reducing batch size in order to make the best utilization of resources	Pettersen (2009)
	Quick changeovers	The ability to changeover from one product to another in a short period of time to allow small but more frequent production runs of the same product	Ohno (1988), pp. 95-97
	Takt-time	Takt is a German word which means beat or rhythm. This tool is used to synchronise the production rate (or rhythm) with customer demand in order to avoid Overproduction. The term originated in the German aircraft industry in the 1930s before it was later taken to Japan by German engineers training Japanese aircraft producers.	Simons & Zokae (2005)

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Category	Tool	Description	References
Process improvement tools	*Value Stream Mapping Techniques*	After identifying value from the customer's perspective, the next step is to identify the value stream for each product	Hines & Rich (1997)
	Kaizen	This refers to continuous improvement events: One of the most basic yet powerful tools of lean. Once a problem is identified, staff from various functions and levels work together in order to find solutions to the problem	Chen, Li & Shady (2010)
	Kaikaku	Unlike Kaizen, these events involve major changes in the workplace including factory layout and machine rightsizing. They are typically carried out at the onset of any lean project	Womack & Jones (1996)
Visualisation tools	*Poka Yoke*	Failure prevention by designing machines in an 'error proof' way	Pettersen (2009)
	5S	A visualisation tool based on the conviction that organizing the workplace is essential to ensuring a smooth workflow. It is based on 5 Japanese words starting with the letter 's' which were later translated to equivalent English words: Seiri (Sort), Seiton (Set in Order), Seiso (Shine), Seiketsu (Standardise) and Shitsuke (Sustain).	Ravikumar, Marimuthu & Chandramohan (2009)

2.4 The FMCG industry

The FMCG industry makes a significant contribution to the world economy. For instance, in the UK, the industry employs over 16% of the total workforce and contributes over 8% of the UK's Gross Domestic Product (GDP) (Bourlakis & Weightman, 2004 cited in Francis, Dorrington & Hines, 2006). It is also the largest sector in New Zealand and the fourth largest in India (Economy Watch, 2010). In Saudi Arabia, although the country's economy is heavily dependent on the oil industry which represents 60% of total investments in the industrial sector, FMCG stands as the third largest industry in the country with 11% of total investments in the industrial sector (Al-Eqtisadia, 2010).

The most significant difference between the FMCG industry and the automotive industry, the "mother" of *lean* manufacturing, is the long setup and changeover time (Found & Rich, 2007). This explains the inclination to produce FMCGs in large batches. In addition to high volume production, product variability is high in FMCG manufacturing since a large portion of products falls under the 'me-too' category, i.e. the need to cover a large product portfolio just to keep up with the competition (Francis, Dorrington & Hines, 2006).

FMCG falls under the business-to-consumer (B2C) category. In this category, it is important to make a distinction between customers and consumers. Customers are typically retailers through whom goods are sold to consumers (Webster, Beach, & Fouweather, 2006). Therefore, the end customer, through whose perception Womack & Jones (2003, p. 16) define value, is in the case of FMCG the consumer (end user) and not the customer (the retailer). The relationship between the manufacturer and its customer, the retailer, is typically characterised by fierce price competition. In addition to this, the small number of retailers and the relatively large number of manufacturers give more power to buyers (retailers) over sellers (manufacturers). This pushes the manufacturers to focus on cost reduction (Webster, Beach & Fouweather, 2006), and it is for this reason that "many FMCG companies emphasise the short term gains of getting [their] stock costs down" (Steele & Plunkett, 1994, p. 16).

2.5 How lean implementation can benefit the FMCG industry

With an ongoing increase in prices of raw and packaging materials, and FMCG companies being under competitive market pressure to maintain their products' selling prices, profitability is directly threatened unless companies implement initiatives to reduce cost (Shabaan & Awni, 2014). Cost reduction through *lean* can be achieved through increased quality (i.e. fewer defects), reduced inventory, improved customer service, shortened order

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cycle time, improved manufacturing and supply chain visibility, improved manufacturing and supply chain flexibility, improved operational performance, increased operational capacity, shortened product development time, and workplace safety and cleanliness (Buxton & Jutras, 2006; Michaels, 1999; Pettersen, 2009; Womack & Jones, 1996).

3. METHODOLOGY

We adopted an exploratory, in-depth, qualitative multiple case-study approach for this research (White, 2000, pp. 39-42). We used a qualitative research because the study was non-numerical and descriptive, and the researchers were often part of the research (White, 2000, p. 28). The real-life experiences of the research participants in the FMCG industry (through personal interviews) provided very rich data which could not have been obtained by using a quantitative research approach. We used the case study approach because of the nature of the research question and objectives (i.e. the use of "how?" and "what?" questions) and the study's focus on contemporary, rather than historical events (Yin, 2009, pp. 8-14). We also used multiple case studies (as opposed to a single case study) to increase the validity of the results and reduce the chance of having unique conditions which may surround a single case (Yin, 2009, p. 61).

3.1 Sample Selection and Criteria

The FMCG industry is categorised into three major segments: food, beverage, and household (Key Note, 2006 cited in Francis, Dorrington & Hines, 2008). Therefore, in order to enhance the external validity of our research, we aimed to cover these three segments by building multiple case studies on three FMCG firms in Saudi Arabia operating in three different FMCG industries: beverages, snacks and packaged baked foods. Of these three cases, the Beverage Company was the main case (with 15 participants interviewed) while the second and third case studies (with three interviews each) were used to replicate the results from the first case study (Yin, 2009, p. 54). In addition, we carried out two confirmatory interviews with one interview with a participant from a Personal Care Products Company based in the UK, and another interview with a US Confectionary Company. These two interviews were aimed at expanding the research coverage. The interview with the participant from the Confectionary Company was the result of a snowballing sampling approach (Müller and Lecoeuvre, 2014), and involved interviewing one of the Beverage Company's participants based on his past experience in a Confectionary Company in the US. These two interviews were used to examine issues emerging from the three Saudi cases which appeared to be regionally based (i.e. issues that were influenced by the business environment in Saudi Arabia), with the aim of identifying if these issues were relevant to the FMCG industries in the UK and the US. This also served to improve the understanding of the findings obtained from the 3 main cases. Table 3 summarizes the number of interviews for each case study.

Table 3 - Summary of interviews

Case Study	Number of Interviews	Number of Participants	Type of Interview
Case Study 1 (Beverage)	9	9	Semi-structured
	1	6	Focus Group
Case Study 2 (Snacks)	3	3	Semi-structured
Case Study 3 (Baked Goods)	2	3	Semi-structured
Confirmatory Interview 1 (Personal Care)	1	1	Semi-structured
Confirmatory Interview 2) Confectionary)	1	1	Semi-structured

3.2 Data Collection

The total number of interviewees was 22 persons and they were interviewed in 17 different sessions comprising 16 individual interviews and a single focus group session for 6 members of the shop floor staff of the Beverage Operations. We selected the interview participants from different functions (manufacturing, warehousing and sales), various levels (directors to shop floor staff) and different years of service (from

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over 12 years of service to less than a year) in the organisations under study. Different perspectives were, thus, brought to bear on the research due to the different participants' backgrounds. In presenting the results for the shop floor staff focus group session, we considered the group's feedback as a single feedback on the basis of unanimity.

Both primary and secondary data were used. Primary data collection was conducted via semi-structured face-to-face interviews in the manufacturing operations as well as observations made by the researchers during site visits. However, the interviews with a participant each from the UK-based FMCG case study and the US-based FMCG case study were made over the phone. Also a site visit to the UK and US facilities was not possible. The interviews were recorded via a digital (MP3) recorder, and later transcribed for subsequent data analysis. The average time for each interview was about 60 minutes and the focus group session was 90 minutes. The type of observation method used was the non-participant (structured) observation (White, 2000, p. 35). Observations included observing general site status in terms of inventory levels, presence of systems and overall conditions of the site. These observations were generally not influenced by the presence of the observer (i.e. the researchers) on the site. Secondary data comprised records of key performance indicators (KPIs) obtained from participating companies. The KPIs included production line efficiencies, inventory levels and forecast accuracy.

3.2 Data Analysis

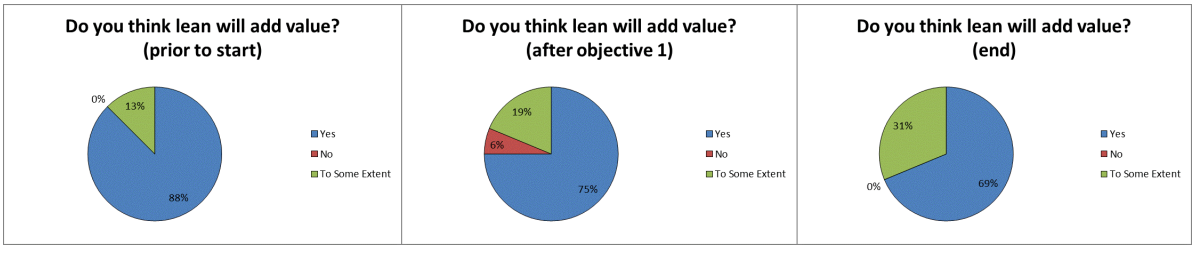
The analysis of the research data (i.e. both primary and secondary data) followed the simultaneous flows of activity proposed by Miles & Huberman (1994, pp.10-11) which encompasses data reduction, data display and conclusion drawing/verification. The data was reduced by allocating chunks of data to previously set categories (Ghauri et al., 1995). The 'set categories' were identified from the literature review prior to conducting the interviews. The display of the data was done using a matrix format via case ordered Meta-Matrix; i.e. Excel spreadsheet (Miles & Huberman, 1994, pp. 187-200). The matrix display was used to facilitate the analysis of the data by identifying themes and categories relevant to the research issues. In addition, the display was used to facilitate comparisons (including similarities and differences) between the cases to aid in drawing up conclusions.

4. RESULTS

4.1 The first research objective

The first research objective was to determine whether lean principles could be implemented in the FCMG industry. Our logic here was that if the seven types of wastes could be demonstrated as evident in the FCMG industry, then lean tools could be used to eliminate the waste. We asked the participants a question about whether lean could be applied to the industry three times during the interviews, i.e. once at the beginning (for participants with some previous knowledge of lean principles), then after completing the segment of questions related to the first research objective and finally after completing the segment of questions related to the third research objective. The rationale for this was to find out whether the participants had developed different opinions based on the discussions. Figure 1 summarizes the results. As can be seen from the figure, by the third time of asking this question, there was no participant who felt lean could not be applied to the FMCG Industry, as 94% of the participants responded 'yes' or 'to some extent', an increase of 6% over the first time the question was asked. The participant who had responded 'no' explained that it was not possible to implement lean under the current operational conditions. These conditions are discussed in more detail later on in this article.

Figure 1 - Participants' responses on the first question on the applicability of lean at different points during the interviews



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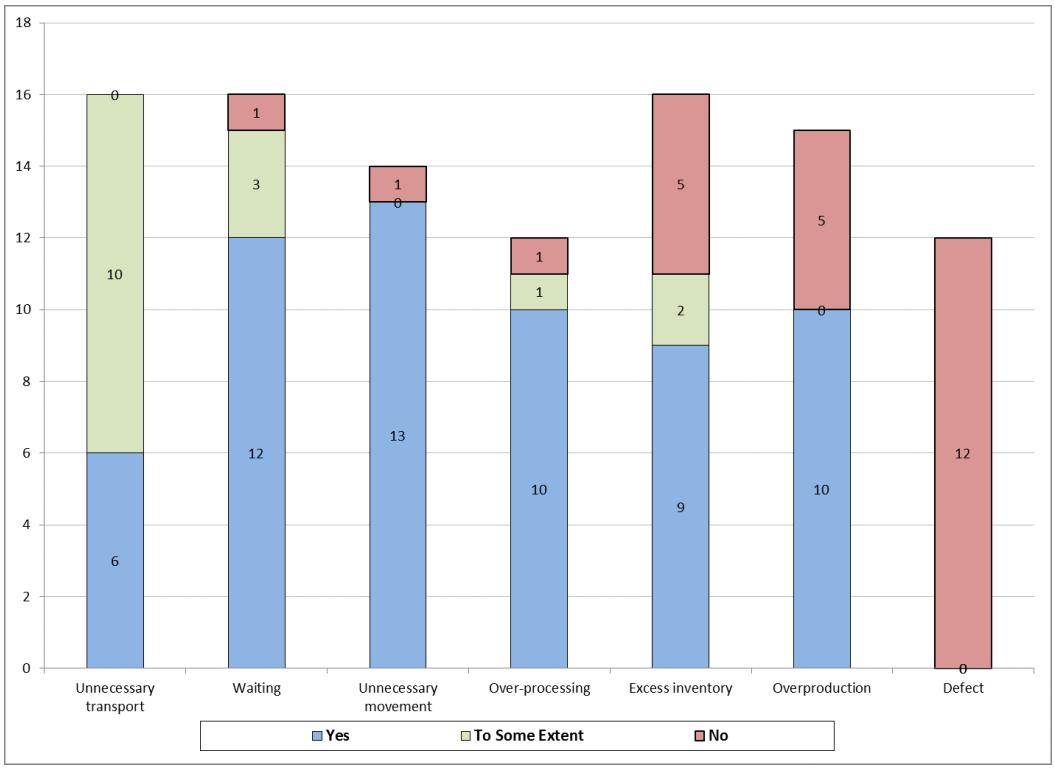
The next series of questions aimed to find out which of the seven wastes were considered by participants as present in the industry. If it could be established that wastes were present, then this would justify the need to implement *lean*. Figure 2 summarises the participants' feedback to these questions.

Figure 2 - Participants' responses on the 7 wastes



Unnecessary Transport was observed by all participants as either present 'to some extent' (63%) or as a 'common practice' (38%). In addition, we observed *Unnecessary transport* to be inherent in the design of the production lines themselves, as there were excessive stretches of conveyors built between machines. These conveyors were not used to simply transport goods, but they also acted as dynamic storage areas for the semi-processed products to protect the lines against stoppage. When we asked participants whether their shop floor staff were idle at any point in time during operation in connection with the waste of *Waiting*, 94% replied that either this was a common observation or it was observed 'to some extent' in their operations. Overstaffing was used to cover absenteeism and to accommodate the peak hours of the day in all three operations. 81% of participants felt that *Unnecessary movement* of shop floor staff was definitely present in their operations, while eleven participants (69%) believed that *Over-processing* was either 'definitely' or 'to some extent' present in their operations due to gaps in the process design and also facility layout restrictions. Most of the participants (68%) felt that the average inventory carried in their operations was excessive and could be reduced, suggesting therefore, that *Excess Inventory*, is a common type of waste. In the Beverage Company and Snacks Operations, this was related to both raw materials and finished goods inventory, while in the Baked Foods Operations, this was only related to raw materials since the average inventory of finished goods ranged from 12 to 24 hours only. While *Overproduction* received 77% positive responses from the participants from the Beverage and the Snacks Companies, it was not considered to be a problem in the Packaged Baked Foods Company. This appeared reasonable since the Baked Foods manufacturer produced only according to customer orders, which was largely due to the relatively short shelf life of its products in comparison with the Beverage and Snacks manufacturers (i.e. a maximum of 45 days in Baked Foods as against 4 months for Snacks and up to 12 months for Beverages). *Defect* was the only type of waste which was systematically monitored in all participating companies' operations in the form of defective raw materials and finished goods before, during and after production. None of the participants was of the view that

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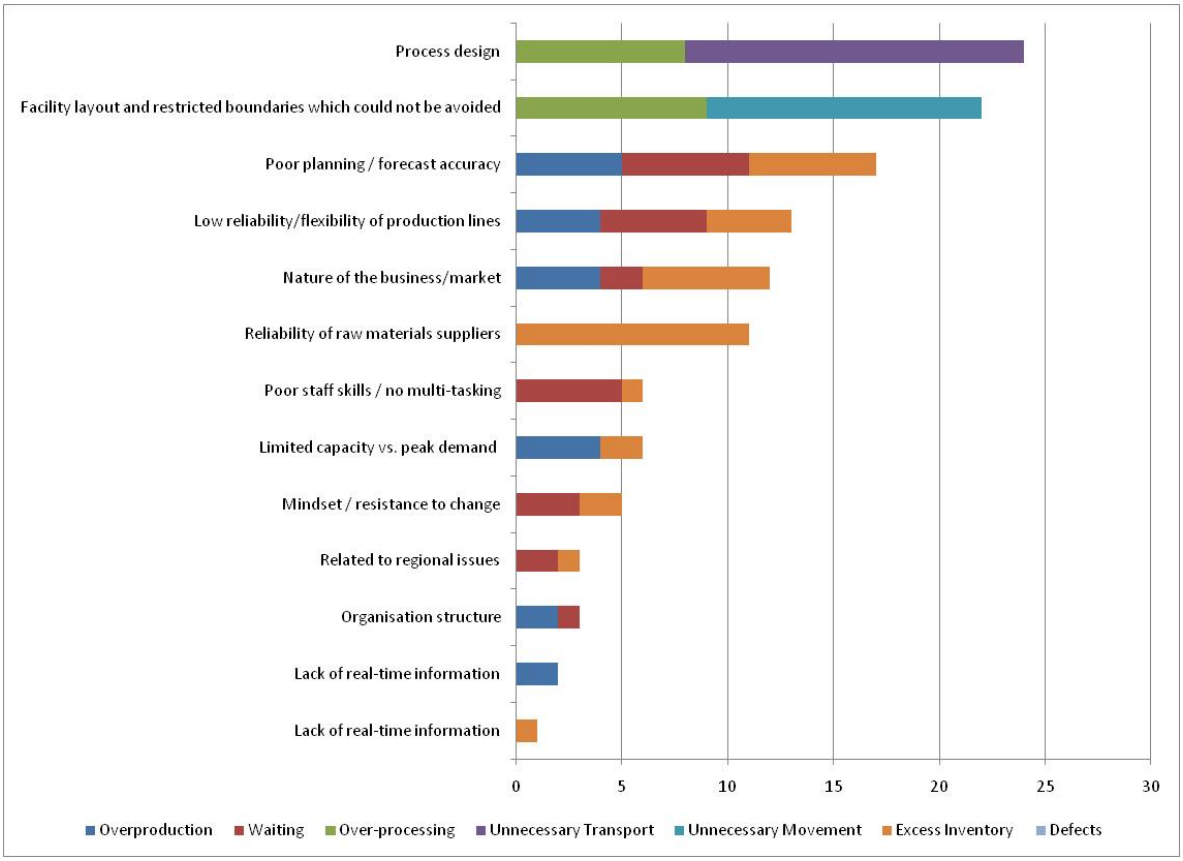
the company's percentage of defects was high. This was also confirmed by the participating companies' internal quality records showing benchmark results both in terms of trade product quality results and in-house defect rates.

During the interviews, we asked the participants about what they believed were the causes of these types of wastes in their operations. Figure 3 summarizes their feedback, which has been categorized according to the type of waste.

Figure 3 - Causes of the seven types of wastes



Deficiencies in process design and facilities layouts were the causes most frequently quoted by participants for the wastes. These, however, were mainly associated with two types of wastes: *Unnecessary Transport* and *Unnecessary Movement*, i.e. the first and third rated types of waste. A close look at the causes, however, shows that reliability of raw material suppliers was the cause cited by the largest number of participants. Overall, the top five causes of waste as mentioned by the participants are as shown in Table 4.

Table 4 - Top 5 causes of waste as cited by participants

Top Five Causes of Waste	Number of Participants	Number of Operations
Reliability of raw materials suppliers	11	3
Low reliability/flexibility of production lines	9	3
Poor planning/forecast accuracy	9	3
Nature of business/market dynamics	8	3
Facility layout and restricted boundaries which could be avoided	7	3

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4.2 The second research objective

The second research objective aimed at examining the conditions under which *lean* principles could be applied in the FMCG industry's operations. In order to understand the conditions which needed to be changed, we asked the participants about which conditions they felt needed to be changed prior to implementing *lean*. Responses to this question varied from one operation to another. While forecast accuracy and supplier reliability appeared to be major issues in the Beverage Operation, mind-set appeared to be the issue in the Snacks operations. Table 5 summarizes the prerequisites to *lean* implementation in FMCG. Its aim is to provide an overview of important aspects and not to make inferences about the issues raised.

Table 5 - Prerequisites to lean implementation in FMCG

Prerequisites to *Lean* Implementation	Number of participants citing this prerequisite	Equivalent % from total participants
Improve planning / forecast accuracy	6	38%
Invest in automation & IT systems	6	38%
Get top management support	4	25%
Improve supplier reliability	3	19%
Improve production line reliability	3	19%
Increase skill level of floor shop staff	3	19%
Improve facility design/layout	3	19%
Change of mind-set	1	1%

4.3 The third research objective

The third research objective aimed to identify which *lean* tools and techniques could be applied to aid a *lean* implementation in the FMCG industry.

4.3.1 Just-In-Time (JIT) tools:

Kanban, the basis of just-in-time, was fairly acceptable with 73% of participants indicating that this tool could be applied either 'fully' or ''in some areas but not others' in their operations. However, further analysis shows that the percentage is skewed upwards mainly by the 3 participants from the Baked Foods manufacturer, who all agreed that *Kanban* can be fully implemented in their operations. This was the case because the downstream operations of the company were already just-in-time (i.e. based on actual customer orders). Participants from the two other operations (Beverage & Snacks) were equally split between 'Yes' (33%), 'No' (33%) and 'To Some Extent' (33%).

Andon was also a point of debate with 53% rejecting it, 40% finding it a useful tool and one participant (7%) saying that it was a good tool but should be implemented with care to avoid excessive stoppages on the production line, as this could in turn result in serious quality issues and increased losses.

4.3.2 Autonomation tools:

The automatic stoppage of the production line (i.e. *jidoka*), received more acceptance (73%) than the manual stoppage (i.e. *andon*). This was mainly driven by 100% acceptance rate from the Beverage Company. The exception was the Beverage company's Warehouse Manager who indicated that it was not applicable in his operations since there was no automation in his area yet.

4.3.3 Production Levelling Tools:

Takt-time was generally dismissed by 79% of the participants. Only the Warehouse Managers of both the Beverage Company and the Snacks Operations indicated that it was applicable in their manual warehousing operations, but not in automated manufacturing operations. Similarly, the Plant Manager of the Baked Foods Operations, saw it as being only applicable in the heavily manual packing area in his plant. Most participants, on the other hand, did not see any value being derived from this tool.

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Heijunka, or production levelling, was discussed from the perspective of the ability to level demand, since in order for a business to be able to level its production, it must be able to level its market demand (Ohno, 1988, pp. 36-38), i.e. level demand across the various seasons of the year and across the various weeks of a month. 44% of the participants did not think this was possible since market demand was seasonal, and this was especially the case in the Baked Foods operations where products must be produced and delivered to customers within their very short life (as short as 7 days in some cases). This means that building up inventory in low-demand months to cover the demand during high-demand months would not apply (and this would also defy the purpose of 'just-in-time' production).

In discussing *Quick Changeover,* participants were asked whether changeover time – which averaged from three to five hours – could be reduced to 30 minutes or less. 90% of participants responded with either 'yes' or 'to some extent'.

A senior participant from the Beverage Company was of the view that applying the concept of small, frequent production runs (which would result from using the quick changeover concept) would be a challenge in the beverage industry because the process of changing over from one batch of syrup to another generates waste in syrup, concentrate and sugar, no matter what the size of the run is; meaning that losses will be heavier if run sizes were smaller.

4.3.4 Process Improvement Tools:

Both *Kaizen* & *value stream mapping* were highly acceptable tools with *Kaizen* receiving 100% acceptance rate, and *value stream mapping* 90%. By contrast, *Kaikaku* (which involves one-time major changes as opposed to continuous small changes in *Kaizen*), was not found to be a useful tool by 60% of participants. However, there were significant variations between the different operations. While the tool received 100% acceptance by the Snacks Operations' participants, it was totally dismissed by the Baked Foods participants. This was explained by one of the operation's participants as being due to "*the nature of our products and the way it is manufactured. They are fixed manufacturing lines*". Similarly 70% of the Beverage Company's participants were of the view that the tool was not helpful to their operations. This appeared to be influenced by the company's plan to build a new manufacturing facility to replace the existing facilities, and this discouraged the will to make major investments to implement changes in the current facilities.

Visualization Tools:

5S and *poke yoke* were generally accepted tools that could be easily implemented in any area of the operation. *5S*, which is already implemented in the Beverage Company's manufacturing operations, received a 100% acceptance rate. Similarly *poke yoke* was found to be a useful tool by all participants, with the exception of the Warehouse Manager of the Beverage Company who indicated that it was not applicable to his manual warehouse operations.

In general, the following factors that differentiate between the packaged goods industry from the automotive industry (where *lean* first started) were mentioned by the participants as obstacles against the use of some *lean* tools and techniques in the beverage industry:

a. Many ingredients in beverage, snacks or baked goods are perishable and would decay or rot if production is stopped frequently. Furthermore, frequent stoppages and start-ups on the continuous production lines would result in degradation of the product quality. This becomes a challenge against the use of *andon* in the industry.

b. Some market mechanics do not allow waiting for consumer (end customer) orders prior to finalizing the production plans. These mechanics include the following:

   - The consumer's decision to purchase is typically done on spot and is not planned ahead. For instance, the Beverage Company's records showed that over 60% of their sales are made to small and medium sized grocery stores, where consumers' decision to purchase are typically spontaneous. If the consumer does not find, for instance, Cola brand A, he/she will simply shift to Cola brand B. It would not be possible to wait for confirmed customer/consumer orders to finalise the production plan. Furthermore, it is not possible to produce all of the company's 120+ products every day. For this reason keeping some inventory in the plant and warehouses and using sales forecasts is considered inevitable. These issues pose a challenge to implementing *kanban* and *takt-time*.

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- Product sales are seasonal. This may also be the case for cars sales as well. However, unlike car purchase, which typically happens once every few years, the purchase of FMCGs is a routine, or even a daily, habit. As highlighted by some participants, consumer promotions typically aim to divert consumers from one brand to another, but do not encourage consumers to forward-buy their requirements in the low sales season several months ahead of the time of consumption. Similarly, sales tend to increase towards month end in the Saudi market. This is because consumers there tend to do bulk buying when they receive their monthly pay checks. These two factors can make it difficult to level demand, a key prerequisite for production levelling (*heijunka*) (Ohno, 1988, pp. 36-38).

4.4. The fourth research objective

The fourth research objective aimed to identify the benefits and drawbacks of implementing *lean* in the operations under study. To achieve this, participants were asked about what they considered would be the benefits of implementing *lean* in their manufacturing and warehousing operations. Table 6 summarises the benefits as foreseen by participants.

Table 6- Foreseen benefits of lean implementation in FMCG

Benefits of *Lean* Implementation	Number of participants citing this benefit	Equivalent % from total participants
Improving performance efficiency	10	63%
Reducing waste	6	38%
Reducing cost	6	38%
Reducing manpower	6	38%
Reducing inventory & storage space	5	31%
Improving quality	4	25%
Improving customer service	4	25%
Improving staff skills	2	13%
Improving performance of raw materials suppliers	1	6%
Improving work environment	1	6%
Healthy growth of business	1	6%

Finally, on the drawbacks of implementing *lean* in FMCG operations, while most participants did not foresee any drawbacks, some participants highlighted a few 'watch-outs'. These are summarized in Table 7. Similar to Table 5, the aims of Tables 6 and 7 are to provide an overview of important aspects and not to make inferences about the issues raised.

Table 7- Drawbacks of lean implementation

Drawbacks of *Lean* Implementation	Number of participants citing this drawback	Equivalent % from total participants
If not implemented correctly, could backfire	5	31%
Some lean tools are not suitable for the industry	2	13%
Some employees would lose their jobs	1	6%
Would require some investment in training to ensure success	1	6%

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4.5 Summary of Results for the Two Confirmatory Interviews

This section looks at the key findings from interviews with a participant each from the UK operations of a multinational Personal Care Products Company, and the US operations of a multinational Confectionary manufacturer. The issues are mainly those emerging from the three main case studies which were considered as regionally-based, i.e. influenced by the business environment in Saudi Arabia. Focus is therefore given to the areas which participants from the three main case studies highlighted as related to the Saudi Arabia region including *Waiting* and *Excess inventory*.

4.6 Personal Care Products – UK operations

The company is already implementing a Total Productive Maintenance (TPM) system, which is, like *lean*, based on Japanese principles, and thus, has many intersecting areas with *lean* such as *kaizen* and *5S* (Venkatesh, 2009). Products typically had a long shelf life (as long as 24 months). Raw materials were delivered just-in-time from either nearby suppliers, or even onsite suppliers. The company produced against forecasts, not actual customer orders, but nonetheless, forecast accuracy level was high by having the forecast refined by customers. The types of waste seen as common in the operations were: *Waiting* (to some extent), *Excess inventory* (in finished goods only), and *Unnecessary movement*. *Waiting* had been significantly reduced in the operations, but not totally eliminated. Although raw materials were delivered just-in-time, the average inventory of finished goods was two weeks. The interview participant was of the view that this level of inventory was not *Excess inventory*, since this inventory was used as a buffer to protect against fluctuations in market demand. *Unnecessary movement* was driven by lack of automation in some areas of the operation, resulting in the use of labour to move materials. This, however, had been corrected in some plants but not in all. The interview participant agreed that all *lean* tools under study would be useful to a *lean* implementation. The only exception, however, was *takt-time*, which he explained as follows: "*Because what we have is a continuous process. We have a minimum time to fill the bottle*".

4.6.1 Confectionary – US operations

This operation was not originally planned as part of the study but was based on a snowballing sampling approach, i.e. a referral by the Project Manager of the Beverage Company (Müller and Lecoeuvre, 2014). The key findings were that production was made against forecasts, not actual customer orders. However, production was made only to the exact forecast quantity without any buffers. As a result, finished goods inventory in the plant was a maximum of two days. Raw materials inventory, on the other hand, was much higher than that, particularly for packaging materials. The types of waste seen as common in the operations were *Waiting* and *Excess inventory* (in raw materials only). *Waiting* was driven by variations in demand and the participant explained this as follows: "*We used to have waiting time. Like, for example, production demand dropped. Sales could not sell it, so we used to have 4 out of 5 days, or actually 2 out of 3 weeks production*". This finding also suggested a need for the productive levelling tool, *Heijunka*. *Excess inventory* was the case only for raw materials, and was mainly because of the vast distances in the US, where suppliers were typically located far from the plant, which could be several states away. *Value stream mapping* and *kaizen* were cited by the participant as systems that were already in place in the Confectionary Operation.

5. DISCUSSION

5.1 The First Research Objective

Although about half of the participants were of the view that *lean* could not be implemented in their operations under their current conditions, while a third of the participants were of the view that *lean* principles could be implemented only partially in their operations, the participants were unanimous in agreeing that *lean* could be applied to their operations. The strong conviction by the participants that implementing *lean* would add value to their operations appeared to be due to the realisation that six of the seven wastes were found to exist in all of the five operations studied. These wastes, ranked from the most to the least as cited by the participants, were: *Unnecessary transport, Waiting, Unnecessary Movement, Over-processing, Excess inventory* and *Overproduction*. Although *Defect* was also present, it was already being monitored by all the operations, and therefore was not considered a justification for *lean* implementation.

The causes of the wastes as suggested by the participants were found to be in line with those identi-

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fied in the *lean* literature review (for example, Liker, 2004, pp. 28-29). However, these suggested that the causes could not be generalised to the FMCG industry as a whole. For instance, the results suggested that supplier reliability, which was seen as the main cause for *Excess inventory*, would appear to be a regional issue since this was not seen as an issue by the participants from the UK-based case study and the US-based case study. Similarly, poor planning/forecast accuracy, which was associated with *Overproduction, Waiting* and *Excess inventory*, was seen as an issue by the participants from the Beverage, Snacks and Confectionary operations, and appeared to be a result of the produce-to-forecast model adopted by these operations. However, this was not an issue in the Baked Foods Operations, where a produce-to-order model was adopted. It was also not seen as an issue in the UK-based personal care products operation although this operation also adopted a produce-to-forecast model, mainly because the company operated an advanced forecasting system where forecasts were developed in line with the customers.

Furthermore, a review of the literature reveals that supplier reliability (which was considered as one of the key causes of waste in this research) is not limited to the Saudi Arabian market. For instance, a study by Hindricks & Singhal (2003), on several multinational firms including Sony, Nike and Ericsson concluded that supply chain disruptions resulting from supplier failures had resulted in an average of 10% decrease in shareholder returns. Similarly, the literature on the FMCG industry such as Adebanjo & Mann (2000), suggests that demand consumer forecasting (which was considered as another key cause of waste by the research participants) is an integral part of the industry and that effective forecasting would result in increased product availability to consumers and lower inventory. Therefore, this study suggests that both supplier reliability and poor planning issues and their subsequent wastes are wastes that generally exist in the FMCG industry.

The results also suggest that the issue of facility layout and restricted boundaries were specific to the operations under study and could not be generalised to the industry as a whole. This was highlighted several times during the interview with the Baked Foods Operation's Plant Manager, who after pointing out the restrictions in his operation clarified that "*this is not the way the industry should be*". It could still be argued, nevertheless, that these types of facility restrictions were typically a result of capacity expansions within existing facilities, which is a very common practice in all industries. Kulturel-Kunak (2007), for example, estimates that more than $250 billion are spent in the US annually on facility layout redesign. This is also supported by the finding that the majority of 4 out of 5 case studies in this research highlighted facility layout restrictions as an issue in their operations.

The view by a third of the participants that *lean* could only be partially implemented in their operations appeared to be mainly driven by one of the major contributors to waste in the FMCG industry; i.e. the 'nature of the business/market'. Under this broad category falls several differences in product characteristics and market dynamics which differentiate the FMCG industry from the automotive industry such as the perishable nature of the products and their ingredients, the spontaneous purchase by consumers and the seasonality of sales trends. This would therefore suggest a need for a customised approach to *lean implementation*, which is also in line with the findings of Bicheno & Holweg (2009, pp. 50-51), who proposed that, depending on the type of industry, a product-process matrix could be used to determine the best way to implement *lean* in an industry. For instance, the matrix recommends that for a high-volume/continuous manufacturing operation such as the FMCG, a *lean* implementation could be best supported by optimisation scheduling tools such linear & mathematical programming (Bicheno & Holweg, 2009, pp. 50-51).

In summary, in relation to the first research objective, all participants agreed that *lean* could be applied in their FMCG operations, which was not surprising since the same types of waste identified by Ohno (1988, pp. 19-20) for the auto industry were seen to be present in the participating FMCG operations as well.

5.2 The Second Research Objective

Responses from the participants suggested that prior to starting a *lean* implementation in their operations some conditions needed to be changed. These are categorized in Table 8.

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Table 8 - Prerequisites to lean implementation in FMCG

Category	Conditions Under This Category
Management	• Securing top management support
Human Resources	• Setting up a structured job rotation scheme in place • Providing *lean* training to staff to overcome *resistance to change*.
Technology	• Investing in information technology • Investing in plant automation
Process Improvements	• Improving sales planning process

The statement that management support is a pre-requisite to a successful *lean* implementation is very much in line with the findings of Moyano-Fuentes & Sacristan-Diaz (2012) who carried out a thorough review of *lean* literature and highlighted that although managerial commitment was not considered until fairly recently, it is of key importance to the success of any *lean* implementation. The authors made references to several studies in a number of different industries which identified lack of management support as the first obstacle when implementing *lean*. The prerequisites under the Human Resources (HR) category are in line with the statement by Bhasin (2012, p. 439) that *lean* literature "dictates that nine of the top ten barriers to change are quoted as being people-related, including poor communications and employee opposition." This is also in line with Shah & Ward (2003 cited in Furlan, Venilli & Dal Pont, 2011) who segmented *lean* implementation into three *lean* bundles, JIT, TQM and HRM, and argued that these three bundles are interdependent and must each be successfully implemented to ensure the success of any *lean* implementation. HRM is linked to the HR aspects on *lean* implementation.

However, while the conditions related to 'Technology' and 'Process Improvement' in Table 7 are suggested as pre-requisites for *lean* implementation, it could however, be argued that these conditions would actually occur as a *result of* rather than as a *prerequisite to lean* implementation. This statement is supported by the *lean* implementation action plan by Womack & Jones (2003, pp. 247-271). Thus, actually, these conditions are not required to be in place prior to implementing *lean*, as they would rather come into existence as a result of implementing *lean*.

Studies on *lean* have identified similar factors as influencing its implementation, several of which intersect with the findings of this research. For example, in a study to develop a full-blown conceptual model for *lean* implementation, Roslin & Shahadat (2014) identified the following to be 'influential factors' in implementing *lean* manufacturing: management commitment, employee empowerment, employee involvement, HR management, teamwork, organizational change, customer relationship management, supplier relationship management, information technology.

5.3 The Third Research Objective

The results suggested that the visualisation tools (i.e. *poke yoke* and *5S*) and the process improvement tools (i.e. *value stream mapping, kaizen* and *kaikaku*) were generally more accepted than the production levelling and JIT tools, which is one of the two pillars of the Toyota Production System (Ohno, 1988, p. 4). This high acceptance rate for the visualisation and the process improvement tools appears to agree with the findings of Abdullah (2003) that *5S* (one of the visualisation tools) and *Value Stream Mapping* (one of the process improvement tools) are "universally applicable", whereas the degree of applicability of other tools depends on the specific characteristics of the process industry under study.

The autonomation tool, *jidoka*, received a high acceptance rate as well with 87% of participants saying that it could be a useful tool in their production operations since their manufacturing consisted of automated, high-speed production lines, which suggests that an automated system would be more capable of capturing errors and defects than humans.

The dilemma, however, was that although participants provided good justifications for rejecting some of the JIT and production levelling tools, the above statements would seem to be paradoxical. This is because, on the one hand, participants appeared to be saying that *lean* could be implemented in their operations, while on the other hand they appeared to be negating this same statement by saying that basic *lean* tools such as *andon, takt-time* and *heijunka* were

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not suitable for their operations. However, a critical analysis of the research results shows that several of the seven types of wastes found in the industries studied were attributed to the 'nature of business/ market'. While a customer buying a car would be willing to wait for several days and even weeks to get the car required, a FMCG consumer would certainly not be willing to wait, even for a few minutes, to get their specific cold refreshing drink, pack of potato chips or bag of bread from the retail outlet, but would simply buy the next available brand on the shelf. Therefore, while Toyota could afford to wait for their customer orders prior to making their final production plans on the assembly line (Ohno, 1998, pp. 48-50), most FMCG manufacturers would have no choice but to rely heavily on sales forecasts based on historical trends. For instance, the Beverage Company's records showed that, historically, forecast accuracy was in the region of 80% for total sales, and 50% by product. These results, although considered good accuracy results as per the Multinational Principal's guidelines, are far from being as accurate as a 'produce-to-order' model. It would appear the participants who rejected *kanban* might have had this preconception in mind, which probably explains why 'improving planning/forecast accuracy' was on top of the list of conditions to be changed prior to *lean* implementation as was suggested by the Beverage Company's participants. However, this preconception would appear to be false since the Baked Foods Operation was successful in planning their production based on actual sales orders from customers. Thus, this would suggest the need for a change of mindset in order to change the way business is done in FMCG industry manufacturing and warehousing operations, as also supported by the findings of the second research objective. A post-interview discussion with the Product Availability Manager from the Beverage Company confirmed this point. He stated that many FMCG companies have actually switched to make-to-order model instead of make-to-forecast.

Therefore, it could be concluded that with the exception of *andon* and *heijunka* (for the reasons previously explained), all of the *lean* tools which were discussed could be implemented in FMCG industries and would support the success of a broader *lean* implementation across the business.

5.4 The Fourth Research Objective

The research participants identified several benefits of implementing *lean* in their operations, including the following: improved performance with respect to efficiency, quality and customer service, reduced waste with respect to cost, manpower and inventory, and improved quality of staff and suppliers. These were in line with those suggested in the lean literature (for example, Buxton & Jutras, 2006; Michaels, 1999; Pettersen, 2009; Womack & Jones, 1996) and it goes to stress the point that reducing cost is actually what *lean* is all about. As noted by the creator of the Toyota Production System, Ohno (1988, p. 9), "Cost reduction must be the goal of consumer products manufacturers trying to survive in today's market place." Another expected benefit from *lean* implementation was inventory reduction or elimination. However, although it was strongly accepted that a significant reduction of inventories (both raw materials and finished goods) could be achieved, none of the participants stated that eliminating inventory altogether was possible in the FMCG industry. This seemed reasonable considering the relatively high level of demand uncertainty in the FMCG industry. Womack, Jones & Roos (2007, p. 295) made a similar observation with respect to Toyota in the afterward of their third edition of *The Machine That Changed the World* that:

> *In fact, Toyota's JIT is far from a zero inventory system because some inventory, what Toyota calls "standard inventory" is still needed in practically every production process, typically near the end. This inventory is proportional to the volatility of orders from the customer and to the stability of the upstream process steps delivering what is needed.*

On drawbacks of implementing *lean*, there were no significant issues. However, some participants cautioned that if the implementation of *lean* was not properly carried out, it could result in a decline in performance and an increase in waste, a point also highlighted by several scholars like Bicheno & Holweg (2009, pp. 44-48), Liker (2004, pp. 10-14), Ohno (1988, pp. 29-30) and Womack & Jones (1996).

5.5 A Conceptual framework for the Application of Lean in the FMCG Industry

From the foregoing discussion, a conceptual framework for the application of *lean* by the FMCG Industry is proposed in Figure 9. The *lean* tools found to be appropriate for the FMCG operations (in Research Objective 3) are used to assist in eliminating the wastes found to be present in the operation, i.e. *Overproduc-*

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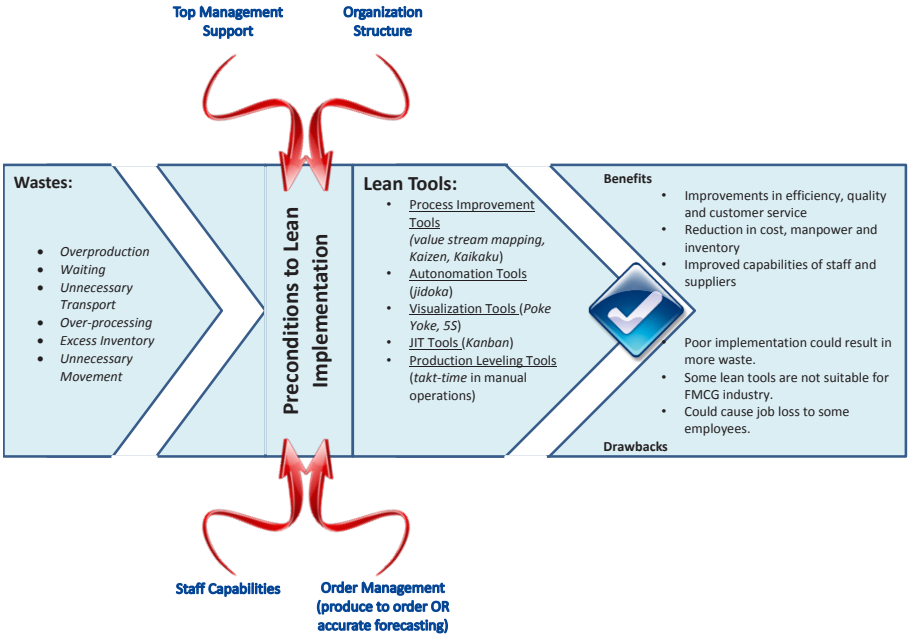
tion, Waiting, Unnecessary transport, Over-processing, Excess Inventory, and Unnecessary Movement (in Research Objective 1). This should be done under the conditions identified as essential to be in place prior to a successful *lean* implementation (i.e. in Research Objective 2) to ensure a successful *lean* implementation. The outcomes of the successful *lean* application are the benefits and drawbacks (in Research Objective 4).

Figure 4 - A Conceptual Framework for Lean Implementation in The FMCG Industry



6. CONCLUSION

This research aimed to cover a gap in the *lean* literature with respect to the applicability of *lean* principles in the FMCG industry from a study of five different FMCG operations. These are: a Beverage Operation, a Snacks Operation, a Packaged Baked Goods Operation, a Personal Care Products Operation and a Confectionary Operation.

Six of the seven types of waste, which were identified in the automotive industry where the *lean* system originated, were found to be also present in the FMCG operations studied. The seventh waste, *Defect*, was also present but was already being monitored by all the operations, and therefore was not considered a justification for *lean* implementation. The identification of these wastes justifies the conclusion that *lean* implementation in FMCG Industry is possible and justifiable to eliminate these wastes and add value. However, due to differences in the 'nature of business' between the automotive and FMCG industries a customised approach including the use of optimisation scheduling tools like linear & mathematical programming (Bicheno & Holweg, 2009, pp. 50-51) would be required to implementing *lean* in the FMCG industry.

Several conditions were found to need changing prior to starting a *lean* implementation in the FMCG operations. These were categorized into four groups: Support, Human Resources, Technology and Process Improvements. Support and Human Resources are genuine prerequisites and were found to be in line with the *lean* literature. It was argued that Technology and Process Improvements, on the other hand, are actually not prerequisites to *lean* implementation but rather steps resulting from the implementation process.

While many of the visualisation and process improvement tools (*5S, poke yoke, value stream* mapping and *kaizen*) were, by their general nature, found to be applicable in the FMCG industry, some of the more specialised just-in-time and production levelling tools could actually end up generating more waste. It is, therefore, important that *lean* tools should not be applied blindly in the FMCG industry but the most appropriate tools should be selected based upon net benefits for the FMCG industry.

Several benefits expected to be derived from implementing *lean* in the FMCG industry manufacturing and warehousing were identified. The most important of these were improvements in performance, quality and customer service and reductions in cost, manpower and inventory. No significant drawbacks were expected from *lean* implementation. Nevertheless, it is possible there could be more waste generation, and job loss for some employees if *lean* is not properly implemented.

This study contributes to filling a gap in the *lean* literature on the applicability of lean principles in the FMCG manufacturing and warehousing operations. The study shows that the argument for the universality of *lean* for all industries (Ohno ,1988, p. 9) appears valid for FMCG operations, although some level of customisation would be required for *lean* to benefit FMCG manufacturers. In addition, the research identifies conditions required for the successful implementation of *lean*, the implementation approach, and also the benefits and drawbacks. Furthermore, we propose a suitable conceptual framework that could be used as a guide for the implementation of *lean* in the operations of FMCG manufacturing organizations.

Although we adopted a qualitative research approach which has the limitation of generalizing the findings, we made the effort to minimize this limitation by employing a multiple case study involving three main categories of the FMCG industry, i.e. food, beverages and household products. In addition, the inclusion of two other cases, one from the UK (Personal Care Products) and the other from the US (Confectionery Products) sought to broaden the otherwise 'regional outlook' of the study and enhance its robustness and external validity.

While the results of this research suggest that *lean* could be implemented in the FMCG operations, further research is still required. In particular, an area for future research could be to test the statistical generalisability of the conclusions from this study. Such research could adopt quantitative methods of data collection by utilising the variables (i.e. the themes) generated in this research and the findings as hypothesis, to provide more external validity to the outcome of this research, and probably also help to refine the conceptual framework so that its usefulness as a tool for theory, practice and policy making may be maximised.

REFERENCES

Abdullah, F. (2003) *Lean Manufacturing Tools and Techniques in the Process Industry with a Focus on Steel*, University of Pittsburgh [Online]. Available from: http://etd.library.pitt.edu/ETD/available/etd-05282003-114851/unrestricted/Abdullah.pdf (Accessed: 17 December, 2010).

Adebanjo, D. Mann, R. (2000) 'Identifying Problems in Forecasting Consumer Demand in The Fast Moving Consumer Goods Sector', *Benchmarking: An International Journal*, 7(30), pp. 223-230.

Al-Eqtisadiah (2010), 25 December [Online]. Available from: http://www.aleqt.com/2010/12/25/article_482821.html (Accessed: 03 January, 2011).

Bhsain, S. (2012) 'An appropriate change strategy for lean success', *International Journal of Operations & Production Management*, 50(3), pp. 439-458.

Bhamu, J. & Sngwan, K. S. (2014) 'Lean manufacturing: literature review and research issues', *International Journal of Operations & Production Management*, 34(7), pp. 876-940.

Bicheno, J. & Holweg, M. (2009) *The Lean Toolbox*, 4th edition. Buckingham: PICISIE Books.

Bunkley, N. (2009) 'Toyota Ahead of GM Sales in 2008 Sales', *The New York Times*, 21 January [Online]. Available from: http://www.nytimes.com/2009/01/22/business/22auto.html (Accessed: 21 July, 2010).

Buxton, m. & Jutras, c. (2006) *The Lean Supply Chain Report*, Aberdeen Group [Online]. Available from: http://www.sap.com/industries/automotive/pdf/BWP_Aberdeen_Supply_Chain_Report.pdf (Accessed: 11 June, 2010).

Chen, J, Li, Y & Shady, B. D. (2010) 'From value stream mapping toward a lean/sigma continuous improvement process: an industrial case study', *International Journal of Production Research*, 48(4), pp. 1069-1086.

Childerhouse, P. & Towill, D. R. (2004) 'Reducing Uncertainty in European Supply Chains', *Journal of Manufacturing Technical Management*, 15(7), pp. 585-598.

Cooney, R. (2002) 'Is "Lean" A Universal Production System? Batch Production in The Automotive Industry', *International Journal of Operations & Production Management*, 22(10), pp. 1130-1147.

Duguay, C. R., Landry, S. & Pasin, F. (1997) 'From Mass Production to Flexible/Agile Production', *International Journal of Operations & Production Management*, 17(12), pp. 1183-1195.

Found, P. & Rich, N. (2007) 'The Meaning of Lean: Cross Case Perception of Packaging Businesses in The UK's Fast Moving Consumer Goods Sector', *International Journal of Logistics: Research & Application*, 10(3), pp. 157-171.

Francis, M. (2004) *Lean Information and New Product Introduction: An FMCG Case Study*, BNet [Online]. Available from: http://jobfunctions.bnet.com/abstract.aspx?docid=312599 (Accessed: 6 June, 2010).

Francis, M., Dorrington, P. & Hines, P. (2006) 'Supplier Led NPD Process Improvement in the UK FMCG Industry: Need and

Method', *International Journal of Innovation*, 12(2), pp. 195-222.

Furlan, A., Vinelli, A. & Dal Pont, G. (2011) 'Complementarity and lean manufacturing bundles: an empirical analysis', *International Journal of Operations & Production Management*, 31(8), pp. 835-850.

Ghauri, P., Gronhaug, K. and Kristianslund, I., (1995), *Research Methods in Business Studies: A Practical Guide*, Prentice Hall, Hemel Hempstead.

Grant, D. B. & Banomyong, R. (2010) 'Design of closed-loop supply chain and product recovery management for fast-moving consumer goods', *Asia Pacific Journal of Marketing*, 22(2), pp. 232-246.

Hines, P. & Rich, N. (1997) 'The Seven Value Stream Mapping Tools', *International Journal of Operations & Production Management*, 17(1), pp. 46-64.

Hines, P., Holweg, M. & Rich, N. (2004) 'Learning to Evolve', *International Journal of Operations & Production Management*, 24(10), pp. 994-1011.

Howison, J. D. (2009) 'A Tough 'Cell': Implementing Lean Production at Toledo Jeep', *Critical Sociology*, 35(5), pp. 689-696.

James-Moore, S. M. & Gibbons, A. (1997) 'Is Lean Manufacture Universally Relevant? An Investigative Methodology', *International Journal of Operations & Production Management*, 17(8), pp. 899-911.

Jones, D. T., Hines, P. & Rich, N. (1997) 'Lean logistics', *International Journal of Physical Distribution & Logistics*, 27(3/4), pp. 153-173.

Kulturel-Kunak, S. (2007) 'Approached to Uncertainty in Facility Layout Problems: Perspectives at the Beginning of the 21st Century', *Journal of Intelligent Manufacturing*, 18(2), pp. 273-284.

Lean Enterprise Institute (2009) *The Machine That Changed The World – Revised* [Online]. Available from: http://www.lean.org/Bookstore/ProductDetails.cfm?SelectedProductID=160 (Accessed: 21 July, 2010).

Liker, J. K. (2004) *The Toyota Way:14 Management Principles From The World's Greatest Manufacturer*. New York: McGraw-Hill.

Michaels, L. M. J. (1999) 'The Making of a Lean Aerospace Supply Chain', *Supply Chain Management: An International Journal*. 4(3), pp. 135-145.

Miles, M. B. & Huberman, M. (1994) *Qualitative Data Analysis: An Expanded Sourcebook*. 2nd Ed, Thousand Oaks: SAGE, Inc.

Moyano-Fuentes, J. & Sacristan-Diaz, M. (2012) 'Learning on lean: a review of thinking and research', *International Journal of Operations & Production Management*, 32(5), pp. 551-582.

Müller, R. and Lecoeuvre, L (2014), 'Operationalizing governance categories of projects', *International Journal of Project Management*, Volume 32, Issue 8, pp. 1346-1357.

Mustafa, S., Dumrak, J. & Soltan, H. (2013) 'A framework for lean manufacturing implementation', *Production & Manufacturing Research: An Open Access Journal*, 1(1), pp. 44-64.

Ohno, T. (1988) *Toyota production System: Beyond Large-Scale production*. Boca Raton: Taylor & Francis Group.

Papahristodoulou, C. (1994) 'Is Lean Production The Solution?', *Economic and Industrial Democracy*, 15(3), pp. 457-476.

Pettersen, J. (2009) 'Defining Lean Production: Some Conceptual and Practical Issues', *The TQM Journal*, 21(2), pp. 127-142.

Ravikumar, M. M., Marimuthu K. & Chandramohan, D. (2009) 'Implementation of lean manufacturing in automotive manufacturing plant [TEL]', *International Journal of Applied Engineering Research*, 4(10), pp. 2041-2050.

Roslin, E. N. & Shahadat, S. A. M. (2014) 'A Conceptual Model for Full-Blown Implementation of Lean Manufacturing System in Malaysian Automotive Industry', *Proceedings of the 2014 International Conference on Industrial Engineering and Operations Management Bali, Indonesia, pp. 1309-1315.*

Shabaan, M. S. & Awni, A. H. (2014) 'Critical success factors for total productive manufacturing (TPM) deployment at Egyptian FMCG companies', *Journal of Manufacturing Technology Management*, 25(3), pp. 393-414.

Simons, D. & Zokaei, K. (2005) 'Application of lean paradigm in red meat processing', *British Food Journal*, 107(4), pp. 192-211.

Spear, S. & Bowen, H. K. (1999) 'Decoding the DNA of the Toyota Production System', *Harvard Business Review*, 77(5), pp. 96-106.

Steele, W. & Plunkett, K. (1994) 'Finished Stock: The Piggy in the Middle', *Logistics Information Management*, 7(6), pp. 16-22.

Towill, D. R. (2007) 'Exploiting the DNA of the Toyota Production System', *International Journal of Production Research*, 45(16), pp. 3619-3637.

Venkatesh, J. (2009) *An Introduction to Total Productive Maintenance (TPM)*, Plant Maintenance Resource Center [Online]. Available from: http://www.plant-maintenance.com/articles/tpm_intro.shtml (Accessed: 15 December, 2010).

Webster, M., Beach, R., & Fouweather, I. (2006) 'E-business strategy development: FMCG sector case study', *Supply Chain Management*, 11(4), pp. 353–362.

Womack, J., Jones, D. & Roos, D. (1990) *The Machine That Changed The World*. New York: Free Press.

Womack J., Jones, D. & Roos, D. (2007) 'Afterword 2007' in *The Machine That Changed The World*, 2007 edition. New York: Free Press.

Womack, J. & Jones, D. (1996) 'Beyond Toyota: How to Root Out Waste and Pursue Perfection', *Harvard Business Review*, 74(5), pp. 140-158.

Womack, J. & Jones, D. (2003) *Lean Thinking*. New York: Free Press.

Wood, N. (2004) *Lean Thinking: What is it and What It Isn't*, Management Services [Online]. Available from: http://www.allbusiness.com/management/960002-1.html (Accessed: 7 July, 2010).

Yin, R. K. (2009) *Case Study Research: Design and Methods*. 4th Edition. Thousand Oaks: SAGE Inc.

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APPENDIX I - INTERVIEW GUIDE

Part I – Background on Lean Principles

Introduction

Mass production, an outgrowth of the industrial revolution, was presented in the US industry with the contributions of Henry Ford and F. W. Taylor in the early twentieth century, which formed the four main characteristics of mass production: reducing cost by increasing production volume, few innovations, supervised labors performing repetitive tasks and adversarial relationship with suppliers. Implementing mass production techniques enabled Ford to reduce production cost of the Ford Model T and sell the model at a price half of competition. However, the model lost its zest in the 1980s when it became apparent that the America auto industry is losing to foreign competition, particularly the Japanese. As a result, a commission lead by the Massachusetts Institute of Technology (MIT) was set up in 1986 to investigate the causes of the phenomenon. The results of the study were published in *The Machine That Changed The World*, a book by Womack, Jones and Roose which documented the superior performance of the Japanese Auto manufacturers in general, but Toyota company in particular based on *lean manufacturing*.

In a way, *lean* manufacturing is similar to mass production in a sense that it "creates outputs using less of every input". The difference between the two, however, is in the *lean* manufacturing's flexibility (ability to offer more variety to customers).

Since the early 1990s, *lean* manufacturing has been successfully implemented across several industries, ranging from small machine manufacturers, to the healthcare sector, and to even the aerospace industry. Lean principles, however, do not appear to have been applied in the Fast Moving Consumer Goods (FMCG) industries.

The aim of this research is therefore to examine the claimed universality by investigating whether *lean* is applicable to the Fast Moving Consumer Goods (FMCG) Industry.

The meaning of lean

When *The Machine That Changed The World* was published, Toyota's sales were half those of General Motors. In 2008, Toyota overtook General Motor's as the world's number one auto manufacturer. The book covers the practices of the Japanese auto industry in general, and the Toyota Production System (TPS) in particular. *Lean manufacturing* is the western name given to TPS.

Muda is the Japanese terminology for 'waste'. Value is the opposite of waste. Companies eliminate waste in order to create value, as perceived by the customers. Taiichi Ohno (1912 – 1990), the Toyota executive who masterminded TPS identified the original seven types of waste:

– *Overproduction*. Producing goods without having customer orders, which results in overstaffing and higher costs of storage and inventory. This is the "most serious" of the seven types of waste as it obstructs the smooth flow of product or information and inhibits quality and productivity.

– *Waiting*. Shop floor workers who set idle either due to wrong workload balancing, or just waiting for the next processing step, or because of out of stock of raw materials. It also occurs when goods are not moving or being worked on.

– *Unnecessary Transport*. The physical transportation of raw materials, finished goods or work in process (WIP). In addition to wasting time, this type of *muda* can also result in damage or deterioration of quality.

– *Over-processing*. Performing unnecessary processing due to poor product or process design. Over-processing leads to poor layout and results in further *muda* in the form of unnecessary transport and poor communication.

– *Excess Inventory*. In the form of raw materials, WIP or finished goods, which results in obsolescence, damage, and high transportation and storage costs. Inventory is a common way to hide problems (poor performance of suppliers or machines) and result in a significant increase in storage costs.

– *Unnecessary Movement*. Any wasted movement employees have to perform during their work, leading to poor productivity and possibility quality issues.

– *Defects*. The production of defective goods. In the TPS, each defect is seen as an opportunity for improvement rather than a problem.

Two additional types of waste were later added:

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– *Poor Design*. Design of goods or services that do not meet customer needs.

– *Untapped employee potential*. Not using potential employee skills or ideas by not engaging them in the process.

In this sense, waste can be defined as "any human activity that absorbs resources but creates no value". Value, on the other hand, is the opposite of waste and is created as wasteful activities are reduced, or if additional features or services are added and are perceived to be valuable by the customer.

In TPS activities are categorized into three types (Liker, 2004, p. 280):

– *Value-adding activities [VA].* Activities that generate value in the eyes of the end customer of the product or service (Francis, 2004).

– *Non-value adding Activities [NVA].* Activities that clearly do not add any value to the product or service and can be removed in the short run with no or minimum capital investment (Francis, 2004). This is type referred to as Type Two *muda* (Womack & Jones, 2003, p. 20).

– *Necessary but non-value adding activities [NNVA].* Activities that do not add value but must be carried out due to constraints in technology, assets or procedures. This is type referred to as Type One *muda* (Womack & Jones, 2003, p. 20).

Lean tools and techniques

The following is a list of the most common *lean* tools, techniques and practices:

– *Value Stream Mapping Techniques*. This aims to distinguish value-adding form non-value adding activities. Several techniques can be used for this purpose: process activity mapping, supply chain response matrix, production-variety funnel, quality filter mapping, demand amplification mapping, value-analysis time profile and decision point analysis.

– *Continuous Improvement (Kaizen events).* One of the most basic yet powerful tools of *lean*. Once a problem is identified, *kaizen* events are used to find solutions to the problem. In these events, staff from various functions work together in order to find a solution.

– *Kaikaku*. Unlike *Kaizen*, this event involves major changes in the workplace including factory layout and machine rightsizing. It is typically carried out at the onset of any *lean* project.

– *Kanban*. Only produce to order, no more and no less, in order to create the flow of one.

– *Andon*. Designing operations to detect errors and stop the operation when an error occurs.

– *Poka Yoke*. Failure prevention by designing machines in an 'error proof' way.

– *Heijunka.* Production leveling by reducing batch size in order to make the best utilization of resources.

– *Takt-time*. The term was introduced in the German aircraft industry in the 1930s before it was later taken to Japan by German engineers training Japanese aircraft producers. Takt is a German word which means beat or rhythm. This tool is used to synchronize the production rate (or rhythm) with customer demand in order to avoid overproduction.

– *Jidoka*. This means automated stop system and is a function of machine design to allow machine to stop when an abnormal situation arises.

– *5S*. A visualization tool based on the conviction that organizing the workplace is essential to ensuring a smooth workflow. It is based on 5 Japanese words starting with the letter 's' which were later translated to equivalent English words:

  » *Seiri*: Sort,

  » *Seiton*: Set in Order,

  » *Seiso*: Shine,

  » *Seiketsu*: Standardize, and

  » *Shitsuke*: Sustain.

5S encourages workers to improve the physical setting of their work and teaches them to reduce waste, unplanned downtime, and in-process inventory. A typical *5S* implementation would result in significant reductions in the square footage of space needed for existing operations. It also would result in the organization of tools and materials into labeled and color coded storage locations, as well as "kits" that contain just what is needed to perform a task.

REFERENCES

Francis, M. (2004) *Lean Information and New Product Introduction: An FMCG Case Study*, BNet [Online]. Available from: http://jobfunctions.bnet.com/abstract.aspx?docid=312599 (Accessed: 6 June, 2010).

Liker, J. K. (2004) *The Toyota Way:14 Management Principles From The World's Greatest Manufacturer*. New York: McGraw-Hill.

Womack, J. & Jones, D. (2003) *Lean Thinking*. New York: Free Press.

Part II - Interview Questions

We have just took a brief preview of *lean* principles, tools and techniques. The research aims to answer the following research question: How can *lean* principles be implemented in FMCG manufacturing and warehousing operations? Next I will be asking you a number of questions to get your views on the research subject. But first, I have this general question: in your view, would *lean* principles be applied in FMCG manufacturing and warehousing? Why do you believe so?

The first research objective is to determine whether or not lean principles can be applied in FMCG Manufacturing and Warehousing operations.

Q1 – Is *overproduction* a common practice in your industry?

- If the answer is yes: why do you think it is a common practice?
- If the answer is no: why do you think it is *not* a common practice?

Q2 – Are shop floor workers idle at any point of time during their working hours, for example: waiting for a machine to complete its cycle? Why do you think this does/does not happen?

Q3 – Are raw materials transported directly from their point of receipt to their point of consumption?

- If the answer is yes: Is there a reason why they are transported directly?
- If the answer is no: why is this the case? Would you consider the in-direct route a type of *unnecessary transportation*?

Q4 – During processing, are the semi-processed products transported directly from one machine to another?

- If the answer is yes: is there a reason why they are transported directly?
- If the answer is no: How are they transported? Why are they not transported directly?

Q5 – Once the production process is completed, are the finished products transported directly from the production line to the plant warehouse?

- If the answer is yes: Is there a reason why they are transported directly?
- If the answer is no: How are they transported? Why are they not transported directly?

Q6 – What is the average time a product spends in a plant warehouse before being shipped to a distribution center?

Q7 – Upon receiving goods in a distribution center, are they directly transported to the order picking area?

- If the answer is yes: Is there a reason why they are transported directly?
- If the answer is no: Why are they not transported directly?

Q8 – Upon picking an order in a distribution center, is the picked order directly loaded on the distribution vehicle?

- If the answer is yes: Is there a reason why they are directly loaded?
- If the answer is no: Why are they not directly loaded?

Q9 – Are there any layout design restrictions in your operations (production or warehouse) that results in *unnecessary processing*?

- If the answer is yes: What are they? Can they not be avoided? Why or why not?
- If the answer is no: go to the next question.

Q10 – Do you think that the inventory carried in your raw materials and finished goods warehouses are too high?

- If the answer is yes: Why do you need to keep such high inventories? What would be the impact of reducing these inventories? If the issues causing these high inventories are resolved, what do you think is the optimum level of inventory that you should be carrying?

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– If the answer is no: Why do you think they are not too high? Are target inventory levels agreed with your finance department?

Q11 – In your opinion, do you think that the current machine layout in production (or the warehouse layout) is the most suited layout for maximizing the utilization of workers? If you are to redesign the production line (or the warehouse) layout from scratch, what would you change in order to minimize a) number of workers, b) the movement of workers?

Q12 – Let us quickly recap. From our discussion, we can say that of the seven types of waste, types [x, y & z] are most common in your industry. Taking this into consideration would you say that *lean thinking* can benefit your manufacturing/warehousing operations? Why or why not?

The second research objective is to examine the conditions under which lean principles can be applied in FMCG Manufacturing and Warehousing.

Q13 – Is it possible to start *lean* implementation in your operations under the current conditions?

– If the answer is yes: Why do you believe so?

– If the answer is no: Why? What are the conditions that must be changed before the implementation?

Q14 – Do you currently have a problem-solving/improvement system in place? Does problem solving involve management as well as floor shop staff?

Q15 – Would you consider your shop floor staff to be multi-tasked or specialized? Why do you believe so? Do you have a job rotation scheme in place?

Q16 – Do you think that the manufacturing/warehousing managers would be willing to support *lean* implementation in their operations? Why do you believe so?

Q17 – Do you think that the manufacturing/warehousing floor shop staff would be willing to support *lean* implementation in their operations? Why do you believe so?

Q18 – Is your current organization structure functional based or process/product based?

Q19 – Do you believe that your current organization structure is the right size for your operations? Why do you believe so?

The third research objective is to identify the lean tools and techniques that can be easily applied in FMCG Manufacturing and Warehousing.

Q20 – Briefly describe, in order of their occurrence, the main activities involved in your operations. Categorize each of these activities as being 'value-adding', 'non-value-adding' or 'necessary but non-value-adding'. Explain the reason for the categorization of each activity.

Q21 – Do you think *kaizen* events can improve your operations? Why or why not? How?

Q22 – Do you think a major *kaikaku* can help improve your operations? Why or why not? How?

Q23 – Do you think that using a pull *(Kanban)* system can improve your operations? Why or why not? How?

Q24 – Do you think that implementing an *andon* system can add value to your operations? Why or why not? Which areas can most benefit from it, if any? How?

Q25 – Do you think that implementing a *poke yoke* system can add value to your operations? Why or why not? Which areas could benefit the most from it? How?

Q26 – Do you think that using *takt-time* can add value to your operations? Why or why not? Which areas could benefit the most from it? How?

Q27 – In order for *lean* to be implemented a system of 'flow' must be created. This system, also known as just-in-time, calls for minimum – or if possible, zero – inventory in the process. From raw materials, to production, to plant warehouse, to distribution center to the customer. In order to be able to achieve this, the following infrastructure must be in place:

a. *Quick changeovers*: production must be done in as short runs as possible. This allows products to be produced only as needed. Longer production runs, although are efficient from the narrow local perspective of production, will generate excess inventory and increase operational cost. In order for the short runs to be possible, the changeover between any two products must be minimal.

b. *Production leveling*: fluctuations in demand, or sudden increases or drops, make production planning more difficult for the plants as well as for the raw materials suppliers. The ability to level pro-

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duction across months, weeks and days with minimum variation will provide the stability required to achieve the flow.

– Do you think that the current changeover times are reasonable? Can they be reduced from their current level to be less than 30 minutes? If yes, how? If no, why?

– If changeover times are actually reduced to be 30 minutes or less. Are there other obstacles that discourage the concept of short production runs?

Q28 – Do you think that implementing the *Heijunka* (production leveling) principle is beneficial in the manufacturing/warehousing operations in your industry?

– To be able to level production across seasons, is it possible to give customer/consumer promotions during low seasons to encourage higher sales during low seasons and lower sales during peak months? If no then why?

– Are sales normally higher towards the end of the month? If yes, why? Is it the consumer pick up trend? Or is it a sales trend? Can this be leveled? If yes, how? If no, why?

Q29 – Do you think that implementing a *jidoka* system can add value to your operations? Why or why not? Which areas can most benefit from it, if any? How?

Q30 – Do you think that implementing the 5S system can add value to your operations? Why or why not? Which areas can most benefit from it, if any? How?

The fourth research objective is to look at the benefits and drawbacks of applying lean principles in FMCG Manufacturing and Warehousing.

Q31 – One of *lean* basics is to ensure that an organization adds value to its customers through their operations and through every new product developed. Do you believe that the 'voice of the customer/consumer' is heard in your organization? Why do you believe so?

Q32 – How is quality measured in your industry? Do you have a high percentage of defects in your operations (either defective goods, or wrongly processed orders)?

– If the answer is yes: Why? Can they not be avoided? Why or why not?

– If the answer is no: Why do you think that the percentage is not high?

Q33 – How is operational cost measured in your operations? How is the cost of defects measured in your operations?

Q34 – With reference to our discussion: in general, do you think that:

– implementing lean principles and using lean tools and techniques will benefit your operations? Why? In what ways?

– Are there any drawbacks to implementing lean principles and lean tools and techniques in your operations? What are they?

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