Strategizing People with Internal Practices towards Successful Implementation of Lean Manufacturing for Customer Satisfaction and Organizational Performance Improvement

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Abstract

The purpose of this study was to review and explore the importance of human resource (HR) and the internal lean practices to group them into a list of significant factors, enabling the manufacturing industries to strategize towards successful lean implementation. There are researches on lean implementation but this work is one of the very first researches to strategize HR with the internal practices towards successful implementation of Lean Manufacturing (LM), which will lead to customer satisfaction and improvement of organizational performance.

Keywords: Lean manufacturing, Lean implementation, HR practices, internal manufacturing practices.

1. Introduction

Lean management is a process improvement technique (Bamber et al., 2014) and lean principles have been recognised as a competitive advantage (Pakdil and Leonard, 2014). Lean manufacturing is gaining popularity as an approach that can achieve significant performance improvement in the industry (Susilawati et al., 2015). The term “lean” was coined by Krafcik (1988), who, at that time was a leading researcher in the International Motor Vehicle Program (IMVP) conducted at the Massachusetts Institute of Technology (MIT). In his landmark paper Krafcik introduced the term “Lean” in order to describe a production system that uses less resources of everything compared to mass production (Papadopoulou. and Ozbayrak, 2005). The innovations at Toyota Motor Corporation, resulting from a scarcity of resources and intense domestic competition in the Japanese market for automobiles, included the just-in-time (JIT) production system, the Kanban method of pull production, respect for employees and high levels of employee problem-solving/automated mistake proofing.

This lean operations management design approach focused on the elimination of waste and excess from the tactical product flows at Toyota (the Toyota “seven wastes”) and represented an alternative model to that of capital-intense mass production, with its large batch sizes, dedicated assets and “hidden wastes” (Hines et al., 2004). The principles, methods and tools of Lean Manufacturing became immensely popular after the release of the book ‘The Machine that Changed the World’ (Womack et al., 1990).

While recent articles have demonstrated a growing recognition of the importance of HRM practices, little attention has been paid to these (Taylor et al., 2013). Although there have been a few studies for the various aspects of HR in lean implementation, there is no comprehensive study of the same. The purpose of this study is to have a detailed study of the relationship of HR with internal practices for the implementation of lean manufacturing, towards customer satisfaction and improvement of organizational performance. The focus of this study is purely on the HR and internal
processes of a manufacturing firm and does not consider quality management, maintenance practices etc. under its purview.

The paper is organized as follows. Section 2 discusses the research methodology. A brief review of literature is presented in Section 3, detailing the research gap, leading to the research questions. The manifest variables have been identified and enumerated in Section 4. The conceptual model thus developed is presented in the same section. Section 5 contains the conclusion and provides scope for future research.

2. Literature Review

The manufacturing era had started with craft manufacturing. Thereafter, there evolved the age of mass production, where same item was produced in large numbers to take advantage of economies of scale. More recently, there is the emergence of the concept of LM (Vinodh and Chinthra, 2011) which is gaining popularity as an approach to achieve significant improvements in the industry (Susilawati et al., 2015). LM is that manufacturing approach which involves an integrated set of activities, that aims to achieve high volume, flexible production, comparable to mass production but using minimal inventories (So and Sun, 2011).

In the past three decades much attention has centred on lean and many researchers have contributed to the definition of LM (Vinodh and Chinthra, 2011). Lean principally focuses on maximizing customer value and eliminating wastes (Kajdan, 2008). It preaches simplification and elimination of wasteful processes which are applicable to overly-complex and non-integrated organisation processes that are inefficient and provide little added value to customers (So and Sun, 2011).

In this paper lean implementation is conceptualized as the execution of manufacturing practices focused on reduction of waste and non-value added activities from a firm’s internal manufacturing operations (Chavez et al., 2015). Being a multi-dimensional concept (Dora et al., 2016; Shah and Ward, 2003), lean includes a variety of management principles and practices under its umbrella (Shah et al., 2008). Recently rigorous academic research has highlighted a broad set of such practices under LM (Shah et al., 2008) to reduce cost through the persistent removal of waste and through the simplification of all manufacturing and support processes (Kajdan, 2008). Focus is on streamlining the internal processes to produce only what is demanded by the customer and only at the necessary time and quantity, thereby utilizing resources efficiently (Chavez et al., 2015).

Though there have been a few hundreds of papers on lean, there have been no such studies to provide a comprehensive list of all the HR practices along with the internal processes towards successful implementation of LM. No single has been found, which may guide the lean practitioner on a This paper is an endeavour to bridge the gap and provide an exhaustive list of the said parameters, focusing on the tools, techniques, methodologies, elements, practices and activities related to HR practices and internal processes. From the review of past literature, this study has attempted to embrace both the technical parameters on one hand and the soft skills on the other hand. More specifically, in the context of the manufacturing industries, the present study seeks to address the following two research questions:

\(RQ1\): What is the comprehensive list of HR and internal variables necessary for successful LM implementation?

\(RQ2\): Is it possible to capture the salient similarities between the identified manifest variables so as to conceptually explore the underlying latent constructs necessary for successful LM implementation?
3. Methodology

The methodology followed by the authors in this study has two fundamental parts. The first part is to analyse the current literature on the role of HR and internal practices for lean initiatives in manufacturing industries. Based on this literature survey, the second part is to suggest a framework incorporating the entire set of HR and internal practices required for lean implementation.

4. Identification of Manifest Variables and Latent Constructs

Based on the research questions posed at the outset, we organize the discussion of our results in the following two sections.

4.1. What is the comprehensive list of HR and internal variables necessary for successful LM implementation?

In the first phase of the research, an intense literature survey revealed eighty six various terminologies related to HR and internal practices as enablers for LM implementation. Since it is practically not feasible to work with 78 separate items, these were verified and based on the similarity of the attributes, combined into 21 manifest variables through a Delphi exercise with seven practitioners and researchers known for their knowledge and experience in LM implementation. These are briefly discussed below.

4.1.1. Workforce Empowerment and Leadership

Empowerment of workforce has been considered as one of the important lean production principles for streamlining operations and decision process (So and Sun, 2011). A self-directed work team (SDWT) is a group of people, usually employees in a company, who combine different skills and talents to work without the usual managerial supervision towards a common purpose or goal. Typically, an SDWT has somewhere between two and twenty five members. Self-directed work teams require that employees are organized in work teams and involved in problem solving groups (Shah and Ward, 2003). Labour utilization has been considered as a relevant lean practice amongst manufacturing and internal management parameter (Susilawati et al., 2015). Strong committed executive leadership is an important requirement for successful lean implementation. Transformational leaders are most in all levels in the company. High level of Effective Leadership helps in higher lean implementation (Ravikumar et al., 2013).

4.1.2. Training and Cross-functional Work Force

Poor skills of workers might lead to sub-standard quality of products and low productivity. The training improves skills and job capabilities of the workers which also help in boosting worker morale (Panizzolo et al., 2012). Training of workers is an essential aspect of lean implementation in an organization. Lean emphasizes the training of workers to improve worker skills. Training helps employees to understand their work better and they are more committed towards it. Workers are given more responsibility after training, thereby, increasing their commitment towards the work (Sangwan et al., 2014). Conceptually, in order for an organization to have a flexible cross-functional work force, it needs to have a job-rotation program, it needs to consider job design, and formal, cross-functional training programs have to be in place (Shah and Ward, 2003). Lean has been distinguished as a bottom up approach where management plays a supportive and facilitating role in engaging shop-floor workers to form cross-functional work teams and apply Lean tools (Shah et al., 2008).

4.1.3. Teamwork and Problem Solving
Teamwork is important in lean efforts, particularly because it provides knowledge sharing opportunities (Pakdil and Leonard, 2014). The problem solving capabilities that arise as a result of empowered work teams can help boost performance by identifying root causes of quality problems, by helping to improve workflow, and by improving equipment efficiency. (Shah and Ward, 2003). This aspect of lean manufacturing will have a significant positive impact on operational performance. In lean philosophy, it is essential to gain support at all levels for implementation of this system – from all managers and all workers (Bowen and Spear, 1999).

4.1.4. Employee Involvement and Satisfaction

Workers must have sufficient participation (Ravikumar et al., 2013). The level of involvement throughout the organization is one of the important factors in successful lean transformations. Research has shown that employee engagement and sustainment of lean are strongly correlated (Lucey, 2009). Lean culture results from engaging employees from all parts and levels of the organization in a consistent means of continuous improvement (Sisso and Elshennawy, 2015). Employee commitment is an essential part for every organization. There is a common belief that implementation of lean helps in creating team spirit and motivating the employees. Organizations could also improve employee motivation by passing down some monetary benefits that arise because of lean implementation (Sangwan et al., 2014). The goal of learning is to provide positive impact outcomes as a result of effective adaptation to environmental changes and improved efficiency in the process of learning. Willingness to learn leads to higher levels of lean implementation (Ravikumar et al., 2013). Innovative performance appraisal and performance related pay systems have been considered as the best practices of HR for a lean enterprise (Panizzolo et al., 2012). Normally, employees get paid to do their jobs. Salaries and other financial benefits are initially adapted to meet the employee satisfaction and the minimum expectation of the job role (Ahmed, 2013). Employee satisfaction is considered essential for lean implementation.

4.1.5. Culture of the Organization

Understanding the culture of the organization is very important for implementation of lean manufacturing (Anvari et al., 2010). In essence, the test of true lean process improvement is the organizational culture and principles that undergird change (Mirdad and Eseonu, 2015). The lean journey is undoubtedly not an easy one. Many organizations who merely go as far as putting in place the various lean components have failed. Wong and Cheah (2011) believe that the missing piece of the puzzle is to possess a corporate culture that promotes a smooth and effective deployment of Lean Manufacturing principles. Therefore, it is of utmost importance to understand what type of culture (e.g. which particular attributes of culture) promotes lean success. Quality improvements are only possible if companies implement comprehensive change management programs addressing “both the organisational and technological aspects of quality management” (Bhasin and Burchar, 2006). According to Bhasin (2008), without an effective change management policy, the lean philosophy for performance improvement breaks down.

Genchi Genbutsu is one of the principles of Toyota, which means, go and see for yourself to thoroughly understand the situation (Ballard and Tommelein, 2012). A big responsibility of the individual is to incorporate the notion of Genchi Genbutsu or “go and see for yourself”. Genchi Genbutsu is the second most important pillar in Toyota’s five pillar culture. Toyota believes that the best way to solve a problem is if the problem is right in front of you. The Genchi Genbutsu method differs from the typical method of problem analysis. Typically, an employee on the assembly line floor will report an issue and a different employee in a remote location will analyze the data and try to find a solution. Toyota believes that this method is erroneous because the employee performing the remote analysis method might not have all of the information needed to solve the problem in front of him. If
this is the case, a solution could be delayed or incorrect. The key purpose of Genchi Genbutsu is that extensive study and gathering of all relevant facts is necessary to obtain a full understanding of situations and problems. Once the study is complete, the widest range of options is considered in designing countermeasures. Then, Toyota seeks full consensus between members of their own groups and other Toyota organizations to find a solution. Once a solution is agreed upon, remedies are implemented quickly and efficiently to meet deadlines (Marksberry, 2011).

The word sensei is used in Japan with some reverence to refer to a teacher who has mastered the subject. A company needs a sensei to provide technical assistance and change management advice when it is trying something for the first time to help facilitate the transformation, get quick results, and keep the momentum building. The lean deployment strategy that can have tremendous benefits is the use of senseis. Senseis are master teachers with significant experience implementing lean, that mentor others on their lean journeys. Senseis should be utilized to help coach executive leaders on lean (Sisson and and Elshennawy, 2015). An expert full time lean consultant is critical for successful lean implementation (Ravikumar et al, 2013). The success of lean initiative seemed to be directly associated with the quality of the change agent. The change agent is the backbone of any initiative taken in the firm; he plays multiple roles. He is the person who co-ordinates improvement activities and acts as a facilitator for the change process (Bateman, 2005). He must possess relevant technical knowledge and soft skills. A crucial task of the change agent is connecting the top management’s vision with the operators’ ideas at the work floor by means of sensitive communication skill. The change agent could be an internal person or an external consultant (Dora et al., 2016).

4.1.6. Role of Top Management

Management commitment and support have been considered as one of the significant critical success factors for lean six sigma deployment to reduce wastes, non-value added work and cycle time, which ultimately have the objective to improve process flow (Bakar et al., 2015). Management must be visibly connected to the project and participate in the lean manufacturing events. A lack of investment by upper management in the lean manufacturing implementation may also affect the success of the implementation in less visible ways. If employees feel that the executive team does not respect their efforts, discouragement may take hold and the lean manufacturing effort will fail. Though it is often desirable to drive change from the factory floor, it is important that a transition to lean manufacturing be driven by the executive management team. The top management should provide necessary infrastructure and training to the organisation employees (Jasti and Kodali, 2015).

4.1.7. Few Levels of Management

Few levels of management had been suggested by Panizzolo and others (2012) for effective lean implementation. In flat organizations, the number of people directly supervised by each manager is large, and the number of people in the chain of command above one is small. A manager in a flat organization possesses more responsibility than a manager in a tall organization because there are more individuals immediately below who are dependent on direction, help and support. Moreover, managers in a flat organization rely less on guidance from superiors because the number of superiors above the manager is limited. The amount of independence managers in flat organizations possess as a result of the flat organizational structure satisfies many of their needs in terms of autonomy and self-realization. The idea behind flat organizations is that well-trained workers will be more productive when they are more directly involved in the decision making process, rather than closely supervised by many layers of management.

The flat organization model promotes employee involvement through a decentralized decision-making process. By elevating the level of responsibility of baseline employees and eliminating layers
of middle management, comments and feedback reach all personnel involved in decisions more quickly. Expected response to customer feedback becomes more rapid.

4.1.8. Vision and Long Term Commitment

Bhasin and Burcher (2006) state that, for effective implementation of lean, there is a need to forward a definite clarity of vision; an indication of what the organisation believes it will look like once the transformation is complete. Lack of a strategic direction and vision of the company towards lean manufacturing could hamper the lean improvement process (Houshmand and Jamshidnezhad, 2006). ‘At the heart of lean is its philosophy, which is a long-term philosophy of growth by generating value for the customer, society, and the economy with the objectives of reducing costs, improving delivery times, and improving quality through the total elimination of waste – muda’ (Wilson, 2010). Focus needs to be given on the long term adoption of lean production principles (So and Sun, 2011). According to Liker (2004), management decisions should be based on a long-term philosophy, even at the expense of short-term financial goals. Undeniably, lean requires a long-term commitment (Bhasin and Burcher, 2006).

4.1.9. Hoshin Kanri

One well-known Japanese management tool is hoshin kanri, also known as policy deployment.

This method breaks down high-level corporate goals into meaningful objectives at the working level of the organization (Liker and Morgan, 2006). Toyota has made clear to its people about the ways to work on a daily basis in order to avoid ambiguity and misunderstanding, by applying the strategy of hoshin kanri, that aligns the resources and explains exactly about the designed goals to be achieved; therefore, each worker works and contributes to achieve the same level of outcomes (Marksberry et al., 2011 and Al-Najem et al., 2012).

4.1.10. Process and Value Stream Mapping

Process mapping is a detailed workflow diagram to indicate the manufacturing flow, for clearer and better understanding of a process required to complete a task. This tool assists in getting the metrics for plotting process improvement (Green et al., 2010). Process mapping activities help to identify improvements in the process flow (Taylor et al., 2013) and assists in lean transformation by identifying opportunities for waste elimination (Cottyn et al., 2011; Mostafa et al., 2013; Velarde, et al., 2011; Vinodh et al., 2011). It has been considered as an ingredient of basic business process improvement (Bendell, 2006) and is a lean method for successful application to a job shop process (Ballard and Tommelein, 2012). It is presented as one of the analytical tools and techniques or attributes under lean philosophy in the workplace (Bateman et al., 2014; Garza-Reyes, 2015; Piercy and Rich, 2015; Prashar, 2014; Stentoft Arlbjorn and Vagn Freytag, 2013) and is an important concept of TPS (Anvari et al., 2011). Process mapping exercise has been considered as a fundamental technical requirement to be practiced by companies (Bhasin and Burcher, 2006). There was concurrence in the information from seven case-study organizations by Bhasin (2012) that process mapping is one of the top five tools engaged within the seven organizations. Process mapping is one of the tools as having high correlation with the best performing companies (Bhasin, 2011). Value Stream Mapping (VSM) technique was used first introduced by Rother and Shook (Chen, 2009) and supports lean practitioners to identify the problematic areas to be improved (Chen, 2009). It is one of the starting tools for applying lean (Drohomeretski et al., 2014) and helps to identify the value in the entire process (Singh et al., 2009). The value stream portrays each step that is performed from raw material to end product and every step is targeted towards customer satisfaction at minimum price. Every role, functions, and responsibilities are designed to make the delivery mechanism more responsive with minimum resources (Singh et al., 2009).
The creation of the Value Stream Map is by itself a value adding process as it helps to have more details and deeper insights of the process (McDonald et. al., 2002). The entire value stream is first depicted visually in the form of a current state map which is studied to identify the various wastes in the process (Barber and Tietje, 2008). The future state map is then developed to illustrate a much improved version of the current state, that minimizes wastes (Basu and Dan, 2014). This future state should be a realistic one. It is essential to develop proper strategy to implement the value stream as depicted in the future state (Braglia et. al., 2006, Singh and Sharma, 2009). The concept has been mentioned in more than 150 papers on LM implementation.

4.1.11. Continuous Flow

Flow is the efficiency of the process that transforms raw material into an end product. This involves analyzing every step in the process that touches and does not touch the end product and goal is to provide a continuous flow without any bottleneck (Singh, Garg and Sharma, 2009). Extensive literature survey reveals that that JIT/continuous flow production is one of the most frequently mentioned practices in literature on lean manufacturing (Shah and Ward, 2003) and accordingly, continuous flow and JIT is considered as synonymous in this paper. Continuous flow is a lean manufacturing practice where one establishes mechanisms that enable and ease the incessant flow of products (Cullinane et al., 2014). The Toyota Production System was based around the desire to produce in a continuous flow (Melton, 2005). Zahraee (2016) expressed that continuous flow is a crucial lean tool for lean manufacturing implementation. It is one among the well-known and most implemented techniques and tools that have been developed to achieve the lean thinking objectives (Bevilacqua et al., 2015).

Continuous flow is one of the lean practices that encompass a wide variety of shop floor manufacturing initiatives (Shah et al., 2008). Establishment of continuous flow where possible is an effective lean technique used for future state mapping (Serrano et al, 2009). It is one of the factors that constitute the operational complement to the philosophy of lean production (Shah and Ward, 2007). One of the tenets of lean production is just-in-time inventory systems that create a production process with continuous flow (Janoski, 2015). According to Alsmadi et al. (2012), there is a significant association between continuous flow (as a lean practice) and firm performance.

4.1.12. Pull System

The Pull system was developed in TPS (Wee and Wu, 2009) from 1949 to 1975 by Ohno and Shingo who had understood the shortcomings of the push system (Kumari et al., 2014). In a ‘push’ system production works as much as it can to replenish stock whereas, in a ‘pull’ system production works only at the pull of customer orders (Melton, 2005) and replaces only what the customer has consumed (Agus and Shukri Hajinoor, 2012). The term pull is used to imply that nothing is made until it is needed by the downstream customer (Arnheiter and Maleyeff, 2005). It regulates the flows on the factory floor driven by demand from downstream that pulls production upstream (Agus and Shukri Hajinoor, 2012, Åhlström, 1998). In other words, in a push system, jobs are pushed from one workstation to the next workstation upon while in a pull system, jobs are pulled by successive workstations, as and when required (Powell et al., 2013). Hence, no one upstream should produce a good or service until the customer downstream asks for it (Powell et al., 2013). This helps in minimisation of work-in-process (Álvarez et al., 2009; Rajenthirakumar et al., 2011; Riezebos et al., 2009; Upadhye et al., 2011), shortening lead times (Arif-Uz Zaman and Nazmul Ahsan, 2014) and reduction of waiting time as well (Rivera and Chen, 2007). The key to the effectiveness of pull systems is that they explicitly limit the amount of work in process that can be in a system (Bokhorst and Slomp, 2010). Pull system is considered as one of the fundamental LM tools and techniques (Almomani et al., 2013; Anvari et al., 2011; Letens et al., 2011; Lian and Van, 2007; Velarde, et al.,
2011) or as one of the lean operations practices (Azadegan et al., 2013). It is one of the principles on which lean production is based on. (Lantz et. al., 2015).

Kanban is a popular lean tool (Abdulmalek and Rajgopal, 2007; Begam et al., 2013) or lean practice (Bayou and Korvin, 2008; Mirdad and Eseonu, 2015, Mostafa et al., 2015; Nordin et al., 2011). Kanban is the Japanese word for “signboard” (Marasini et al., 2014; Melton, 2005). It is a visual symbol that helps the flow in the process as per the requirement of the customer (Zahraee, 2016). In this system, each work centre does not make anything until the following work centre requests for it (Melton, 2005). The kanban system of production control was introduced in 1985, which helped to develop and maintain discipline on the shop floor (Sohal, 1996). It reduces inventory, unnecessary movements of raw materials, prevents overproduction and allows the operator to visualise the whole schedule at a glance (Marasini, 2014). Kanban is one of the most implemented lean tools (Bevilacqua et al., 2015, Belekoukias et al., 2014) and it is that enabling technique of LM (Vinodh and Chintha, 2011) which controls the material flow extending the reach of manufacturers from upstream suppliers to downstream customers (So and Sun, 2011). Fullerton et al. (2014) consider Kanban system as one of the elements representing LM. Bhasin and Burcher (2006) suggest that “a kanban system needs to be in place” for LM.

4.1.13. Value Analysis and Waste Elimination

Value analysis is a collaborative activity (Tuli and Shankar, 2015) to synchronize the activities of design with those of manufacturing for the purpose of producing a higher quality, lower cost product. The design engineer assesses the characteristics of the product, the customers who will buy it and how they will use it in light of the company’s strategic goals. This information is then used to make tradeoffs concerning costs versus product features. Value analysis helps to reduce the cost of the product by analyzing the costs of each manufacturing step and identifying the steps that have the most critical effects on cost (Jayaram, et al., 2008). Hence, value analysis is a technique to assess the value content of the elements of a product or process and value is what people are willing to pay for (Upadhye et al., 2010). Value analysis is one of the key practices associated with lean (Jayaram, et al., 2008, Deflorin and Scherrer-Rathje, 2012) and lean thinking focuses on the reduction and removal of wastes by value analysis (Bendell, 2006) which has been considered as one of the vital tools and techniques to implement LM system (Upadhye et al., 2010).

LM focuses on elimination of waste as its principal objective (Pettersen 2009; Shah and Ward, 2007; Vinodh and Chintha, 2011). Waste elimination is one of the key principles on which LM is based on (Vinodh and Joy, 2012). Lean is a high-level philosophy, focused on waste elimination (Haque and James-Moore, 2004). Any operation which does not add value to the end product is to be considered as waste (Gupta and Jain, 2013). In other words, any operation which results in a physical transformation of the product is not to be considered as waste. Waste and value should be viewed from the customer’s viewpoint and this augments the process of identification and subsequent reduction of waste. If an activity adds any such attribute to the product, which the customer wants and is ready to pay for the same, then such an activity is not a waste. In the manufacturing context various operations are categorized into non-value adding (NVA), necessary but non-value adding (NNVA) and value-adding (VA). NVA operations are pure waste and should be eliminated completely. NNVA activities should be reduced to the maximum extent possible by making certain changes in the process. In other words, waste elimination is getting rid of what does not belong to the value stream (Paez et al., 2004).

Opportunities for waste elimination could arise in a multitude of areas including raw materials, work-in-process inventory, scrap, quality defects, overproduction, transportation, time, labour, energy, space, complexity and motion (Abdulmalek et al., 2006). The seven commonly accepted wastes in the Toyota Production System are overproduction, waiting of materials and/or workers, transport, inappropriate processing, unnecessary inventory, unnecessary motion and defects (Hines and Rich,
1997). Underutilization of employees is recently being considered as the eighth waste (Vinodh and Chintha, 2011). The elimination of waste helps to reduce cost and organise the required, value-creating production activities into an efficient system design that facilitates smooth production flow with minimal interruptions, delays and variations (Lyons et al., 2013). There is unanimous agreement amongst researchers and practitioners that waste elimination is an integral part of LM (Lyons et al., 2013).


Cycle time reduction is the strategy of improving productivity by lowering the time it takes to perform a process. According to Shah & Ward (2003), both work-in-process (WIP) inventory and unnecessary delays in flow time can be reduced by cycle time reduction which is considered as one of the lean practices (Cezar Lucato et al., 2014; Doolen and Hacker, 2005) or lean concepts and tools (Fliedner and Mathieson, 2009; Marley et al., 2013). Hence, cycle time reduction aims at reducing or eliminating waste. Cycle time reduction has been considered as one of the categories of lean thinking methods or culture, that have in the makeup of successful lean manufacturing implementation (Shetty et al., 2010). Reduction in cycle time can be achieved by several ways by eliminating the NVA or non-value adding activities (Nepal et al., 2011). Though adequate importance has not been given to cycle time reduction in past literature (Gurumurthy and Kodali, 2011), the same will be considered as one of the manifest variables for lean implementation since in this research work, an attempt has been made to make an exhaustive initial list of the manifest variables to be considered for LM implementation.

Lead time reduction is one of the areas lean focuses on to satisfy customers (Carvalho et al., 2011; Garza-Reyes, 2015) and should involve everyone in the organisation (Garza-Reyes, 2015). Lead time indicates the time between raising the demand by customer and receiving the product of his choice (Agarwal et al., 2006). TPS has its focus on reduction of lead time which then has benefits in cost, quality, and delivery (Liker and Morgan, 2006) Implementation of reduction of lead time as a lean practice helps to improve productivity (Papadopoulou and Özbayrak, 2005). Susilawati et al. (2015) consider lead time reduction of product development and market research as a lean practice while according to Ghosh (2012) reduced manufacturing lead time is one of the main drivers of lean implementation. Lead time reduction has also been considered as one of the characteristics associated with lean production (Pettersen 2009) or as one of the lean practices (Mirdad and Eseonu, 2015). However, reduced lead time is one of the most cited benefits of LM implementation.

4.1.15. Setup Reduction

Setup reduction is a process to reduce the setup time based on Single Minute Exchange of Dies or SMED (Abdulmalek et al., 2006; Almomani et al., 2013). It is necessary to eliminate delays in change-over times on machines to reduce the lead-time and improve flows. (Bhasin and Burcher, 2006) Important work in the area of reduction in setup times was done at Toyota following the Second World War. Through the creative method of SMED, developed by Shingo, set-up times in large punch presses could be reduced from several hours to less than ten minutes (Karlsson and Åhlström, 1996). SMED is one of the 15 tools and techniques Shingo schedules for lean implementation in a year (Anvari et al., 2011). Setup reduction has been considered as one of the enabling LM techniques (Serrano et al, 2009; Vinodh and Chintha, 2011), and the same can be quantified and modelled objectively (Abdulmalek and Rajgopal, 2007). It is a method used by many companies to successfully implement lean manufacturing (Black, 2007; Marodin and Saurin, 2013). Chen and Meng (2010) found that setup reduction has proved to be one of the effective lean tools during the inception of lean production in Chinese industries.
4.1.16. Time Management and Scheduling

Time management has been considered as one of the criteria of manufacturing strategy leanness by a few authors (Vinodh and Chintha, 2011a, 2011b; Vinodh and Joy, 2012). On the other hand, planning and scheduling has been considered as an important LM tool (Bayou and Korvin, 2008; Shah and Ward, 2003; Upadhye et al., 2010). In many research papers production scheduling has been considered as an LM tool (Dettty and Yingling, 2000; Susilawati et al., 2015). There have been elaborate discussions on scheduling in LM (Karlsson and Åhlström, 1996; Sohal, 1994). Many authors have focused on mixed model scheduling, synchronized scheduling and under-capacity scheduling (Gurumurthy and Kodali, 2009, 2011; Panizzolo et al., 2012, Papadopoulos and Özbayrak, 2005). Effective workers scheduling and machine scheduling are important to organisation to achieve leanness level (Wong et al., 2014).

Scheduling has been considered as a factor for LM implementation; in LM environment, empowered teams are responsible for job scheduling (Meybodi, 2013). Scheduling flexibility has been considered as a practice/tool of LM (Belekoukias et al., 2014). Being a non-human aspect in LM (Taj, (2005), effective schedules enable a firm to satisfy customer orders, reduce inventory by allowing smaller lot sizes and reduce work in processes (Wong et. all, 2009). According to Wong et al. (2009), appropriate scheduling methods are able to optimize the use of resources. Since scheduling has been considered as a key area in LM (Salimi et al., 2012; Thanki and Thakkar, 2014; Wong et. all, 2009), time management and scheduling have been considered as a single variable for this study.

The takt time is the heartbeat of a lean system. (Deflorin and Scherrer-Rathje, 2012) Takt time control is a concept that reflects production rate must be imposed by the product demand (Serrano Lasa et al., 2008), i.e., the production rate must match the customer requirements (Abdulmalek and Rajgopal, 2007; McDonald et al., 2002). Takt is the German word for a conductor’s baton, which is used to keep orchestra members, all in time (Black, 2007). In a manufacturing process, takt time is the ideal production pace (Pakdil and Leonard, 2014) which is equal to the customer’s rate of product demand. It is calculated by dividing the available production time by the customer demand (Bokhorst and Slomp, 2010). Takt time not only ensures that customer demand is met (McDonald et al., 2009) but also refers to the synchronization of the pace of one process with that of other processes (Seth and Gupta, 2005). Hence, it is a benchmark for the pace of the process (Rahman and Karim, 2013). Takt time is one of the elements of the JIT bundle, application of which is the key to the success of LM implementation (Begam et al., 2013; Mostafa et al., 2015). Takt time is therefore considered as one of the lean tools (Fliedner and Mathieson, 2009; Jasti and Kodali, 2014, 2015), practices (Lyons et al., 2013; Marodin and Saurin, 2013) or techniques (Chauhan and Singh, 2012).

4.1.17. Visual Management

Visual management on the manufacturing shop floor involves various simple clear visual communication / control tools (Fullerton et al., 2014) to make the process transparent, visualised and thus easily allow detection of abnormality or defects (Gao and Low, 2014). It improves the operation of a factory (Bhasin, 2008). Visual management, a lean enabler (Saurin and Ferreira, 2009), is one of the foundations of the TPS and is designed to ensure visibility (Oon, 2013) in order to provide quick and clear operational status of the production system (Dettty and Yingling, 2000) so that when problems or deviations from standards occur, they can be quickly noticed by all and resolved. Visuals also clarify expectations to ensure that everyone is focused on meeting them. (Sisson and Elshennawy, 2015). Fullerton et al. (2014) have expressed that the use of visual performance measures is positively related to operations performance. Visual management aims to make information available, timely and understandable. It makes everyone along the process able to manage, improve, control and correct any variation from requirements. (Bevilacqua et al., 2015) In visual management, visual control systems or andons are often used that allow operators to signal problems of quality or uncompleted tasks (Belekoukias et al., 2014, Huxley, 2015). Use of visual management or aids is therefore considered as
one the important lean practices (Mirdad and Eseonu, 2015; Susilawati et al., 2015) or lean tools to achieve LM improvement effectively (Eswaramoorthi et al., 2011; Mostafa et al., 2015).

4.1.18. Production Smoothing (Heijunka)

Heijunka is a Japanese word which means levelling (Liker and Morgan, 2006) or production smoothing (Singh et al., 2014). Production smoothing or bottleneck removal (Shah and Ward, 2003) is a levelling mechanism (Powell et al., 2013) whose goal is to create a level work load. (Liker and Morgan, 2006). Heijunka or production smoothing is a lean concept based on production rhythm monitoring and internalisation (Serrano et al, 2009). It is a process designed to keep the production level as constant as possible from day to day (Abdulmalek et al., 2006). It is the adaptation of the production system to fluctuating demand (Paez et al., 2004) in order to achieve a stable and reliable workflow (Gao and Low, 2014). Lean practices and techniques focus on streamlining processes (Shah et al., 2008; Vinodh and Chintha, 2011) to minimise variations and thereby to facilitate cost reduction (Modarress et al., 2005; Vinodh and Joy, 2012) and improve operational performance (Alsmadi et al., 2012). Lean is about streamlining the flow of value through an organization. (Bariya and Desai, 2014).

LM stresses on creating a balanced flow in a process (Pakdil and Leonard, 2014). In lean production, the work processes are carefully designed to achieve a perfectly balanced production system, in which everyone is working at the same pace. In other words, line balancing, is a lean tool (Karim and Arif-Uz-Zaman, 2013) and a synchronization process, ensures that workstations are working neither faster nor slower than other workstations for which parts are supplied to or received from (Abdulmalek et al., 2006). Production/process streamlining is a LM strategy that can offer a steady path towards business excellence. According to Black (2007), levelling and balancing the manufacturing system is a lean production methodology for implementation. Hence, heijunka or production/process smoothing or line balancing is considered as one of the LM manifest variables.

The bottleneck is a system limitation (Serrano et al, 2009) and chokes production (Panizzolo et al., 2012). The bottleneck reduces productivity and creates both blockage and starvation in the productive system (Taj and Berro, 2006). Poor coordination between different steps in the production process often creates bottlenecks. (Panizzolo et al., 2012) Bottlenecks in the production process are to be identified and corrective actions are to be taken for their removal (Belekoukias et al., 2014; Panizzolo et al., 2012). Hence bottleneck analysis is a common lean practice for implementation. One of the lean principles is to eliminate bottlenecks (Shetty et al., 2010) where the cycle time for one process hinders the throughput of other, faster processes (Barber and Tietje, 2008). The goal of LM is to provide a continuous flow without any bottlenecks (Singh, Garg and Sharma, 2009) and for that reason, bottleneck activities need be optimized (Bamford et al., 2015).

The Theory of Constraints aligns with lean thinking in the way it considers an organization as a system consisting of resources which are connected by processes. It effectively talks about a value stream and the main causes for the lack of flow—constraints in the system. Goddatt and Cox introduced some development of operational rules to guide how a production plant should be (Melton, 2005).

4.1.19. Lot Size Reduction and Single Piece Flow

It is one of the key approaches to follow to become lean (So and Sun, 2011). Shah et al. (2008) considers it to be an important element of the lean bundle. Reduction of production lot size is a major source of inventory reduction (Upadhye et al., 2011) and hence lot size reduction is often used to
lessen inventories and to avoid overproduction (Wong et al., 2009). Doolen and Hacker (2005) consider lot size reduction as one of the important LM principles and practices affecting shop floor management. Lean production emphasizes on small batches (Arnheiter and Maleyeff, 2005) with frequent deliveries (Jadhav et al., 2014). To produce in small batches is very important for implementing lean (Panwar et al., 2015). The manufacturing approach of TPS was to produce a small batch of products in the lot that resulted in fewer inventories and less capital investment to produce the same number of products (Jasti and Kodali, 2016). This helped them to identify the value of each process and the contribution of each activity to the customer. Production in small batches with short lead times also helps to rapidly respond to changes in the customer requirements (Almomani et al., 2013). Moreover, a steady flow of materials in small batches allows a faster replenishment of materials, and this helps to shorten lead time and increase productivity (Wong et al., 2009). Therefore lot size reduction may be considered as a common lean practice (Al-Tahat et al., 2015; Belekoukias et al., 2014; Marodin and Saurin, 2013; Prakash and Prasad, 2014; Shah and Ward, 2003, Susilawati et al., 2015) or tool (Panwar et al., 2015).

Single piece flow (SPF) is one of the basic concepts of lean philosophy (Nepal et al., 2011) or an important LM tool (Bhasin, 2011; Eswaramoorthi et al., 2011). Bhasin and Burcher (2006) dwell on the concept of SPF for companies to practice for LM implementation. They define single piece flow as, “Where products proceed, one complete product at a time through various operations in design, order taking and production, without interruptions, backflows or scrap.” LM promotes the concept of SPF (Arnheiter and Maleyeff, 2005; Haque and James-Moore, 2004), i.e., the transfer batch should be one (Arnheiter and Maleyeff, 2005). SPF is the ultimate ideal of LM (Arnheiter and Maleyeff, 2005). Developing SPF methodology in the manufacturing process implies that every part and every assembly is checked after each processing step (Black, 2007). SPF results in reduction in lead times, proper load distribution among process associates, and faster detection of problems (Nepal et al., 2011).

4.1.20. Equipment Layout & Material Handling

Shah and Ward (2007) consider equipment layout as one of the key measurement instruments of lean production while the same has been considered as an effective LM practice by Bortolotti et al. (2015) and Nordin et al. (2011). Plant and equipment layout for continuous flow has been regarded as a dimension of lean systems by Taylor et al. (2013). One of the key lean areas is plant layout and material handling (Thanki and Thakkar, 2014; Wong et. all, 2009), where equipment layout needs to correspond to the sequence of operations and minimize material handling (Forza, 1996). Equipment layout is one of the frequently cited lean practices (Salimi et al., 2012) and is judged as a lean tool affecting Key Performance Indicators (Alaskari et al., 2016).

Layout/handling has been considered as a key issue to LM by Taj (2005) in his study of lean manufacturing implementation in the electronics, telecommunication/wireless and computer industries in China. Flexible facility layout, with minimum materials handling losses and less movements and inventories between stations, is important for LM implementation (Jadhav et al., 2014). In other words, implementation of LM is dependent on the flexibility inherent in the manufacturing process, which is majorly dictated by the type of equipment and facility layout (Abdulmalek et al., 2006). Optimal benefits can be gained when equipment layout is combined with the effective metrics for material handling (Green et al., 2010).

4.1.21. Work Standardization

Work standardization is considered to be a relevant lean practice (Singh et al., 2010; Susilawati et al., 2015). It is crucial to standardise work processes in order to achieve lean manufacturing (Pullan et al., 2013) Need for standardization is one of the fundamental practices of leanness (Papadopoulos and Özbayrak, 2005). Leanness of a business process depends on how efficient its Standard Operating
Procedures (SOP) are (Kajdan, 2008). It is essential to adapt standard operating procedures especially for labour-intensive manufacturing firms as lack of it can affect productivity and safety of workers (Singh et al., 2014). Standardized work has often been considered as a lean principle/practice (Almeida and Saurin, 2015; Deflorin and Scherrer-Rathje, 2012; Gao and Low, 2014; Lyons et al., 2013; Mirdad and Eseonu, 2015; Mostafa et al., 2015; Seth and Gupta, 2005). Lean places strong emphasis on the standardization of work (Pettersen 2009). According to Shetty et al., process and product standardization is one of LM management strategy (Shetty et al., 2010). Even TPS includes standardization of work (Spear and Bowen, 1999, Haque and James-Moore, 2004) as its practice. Standardization is one of the important features of lean production. LM emphasizes the idea of continuous improvement and any such modification will result in new standards – the newly defined standardized tasks can still be easily rotated among operators (Huxley, 2015). Standardization of work is seen as the foundation for continuous improvement. (Lantz et. al., 2015). Moreover, LM attempts to reduce task time variation by establishing standardized processes (Deflorin and Scherrer-Rathje, 2012; Liker and Morgan, 2006) and work procedures. (Arnheiter and Maleyeff, 2005).

4.2. Is it possible to capture the salient similarities between the identified manifest variables so as to conceptually explore the underlying latent constructs necessary for successful LM implementation?

The 21 manifest variables are conceptually grouped under five eleven distinct latent constructs, considering the salient inherent similarities between them (Table 1).

Table 1. Input Manifests and Latent Constructs related to HR and Internal Processes for successful LM implementation.

<table>
<thead>
<tr>
<th>Latent Construct</th>
<th>Manifest Variables</th>
<th>Attributes collated from Literature Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Training and Cross-Functional Workforce</td>
<td>Individual Training / Team Training / Employee Development / Multi-Skilled Workers / Labour Flexibilization / Workforce Capability</td>
</tr>
<tr>
<td></td>
<td>Teamwork and Problem Solving</td>
<td>Problem Solving by all / Gain Support at all Levels / Teamwork / Effective Team Management / Roles &amp; Responsibilities / Decision Making / Nemawashi / Respect for People / Respect for Humanity</td>
</tr>
<tr>
<td></td>
<td>Employee Involvement and Satisfaction</td>
<td>Employee Spirit / Cooperation / Involvement / Morale / Motivation / Commitment / Willingness to Learn / Innovative Performance Appraisal / Performance Related Pay System / Rewards &amp; Recognition / Incentives / Employee Satisfaction</td>
</tr>
<tr>
<td></td>
<td>Culture of the Organization</td>
<td>Culture of the Organization / Change Management / Genchi Genbutsu / Facilitator Sensei or Engagement</td>
</tr>
<tr>
<td>Management Role (MR)</td>
<td>Top Management Support</td>
<td>Top Management Involvement / Support / Suitable Infrastructure with required Resources, Tools</td>
</tr>
<tr>
<td></td>
<td>Few Levels of</td>
<td>Flat Organization</td>
</tr>
<tr>
<td>Latent Construct</td>
<td>Manifest Variables</td>
<td>Attributes collated from Literature Survey</td>
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<td>------------------</td>
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<td>-------------------------------------------</td>
</tr>
<tr>
<td>Management</td>
<td>Vision and Long Term Commitment</td>
<td>Clarity of Vision / Long Term Commitment / Long Term Strategy / Long Term Philosophy</td>
</tr>
<tr>
<td></td>
<td>Hoshin Kanri</td>
<td>Hoshin Kanri / Policy Deployment</td>
</tr>
<tr>
<td>Integrative Planning and Scheduling (IPS)</td>
<td>Cycle and Lead Time Reduction</td>
<td>Reduction of Cycle Time / Reduction of Lead Time</td>
</tr>
<tr>
<td></td>
<td>Production Smoothing</td>
<td>Heijunka / Streamlining Manufacturing Process / Balanced Operations / Production Leveling / Production Smoothing / Reduction of Mura (Unevenness) / Line Balancing / Bottleneck Removal / Removal of Constraints / Theory of Constraints / Commercial Actions to Stabilize Demand</td>
</tr>
<tr>
<td></td>
<td>Time Management and Scheduling</td>
<td>Takt Time Control / Proper Scheduling / Planning &amp; Scheduling Strategies</td>
</tr>
<tr>
<td></td>
<td>Work Standardization</td>
<td>Standardization of Manufacturing Processes / Standardization of Work / Standardized Work</td>
</tr>
<tr>
<td>Internal Operations Synchronization (IOS)</td>
<td>Continuous Flow</td>
<td>Just-In-Time / Continuous Flow Production without Interruptions, Backflow or Scrap</td>
</tr>
<tr>
<td></td>
<td>Pull System</td>
<td>Pull Production / Kanban System</td>
</tr>
<tr>
<td></td>
<td>Setup Reduction</td>
<td>Quick Changeover Techniques / SMED / Setup Reduction / Reducing Setup Time</td>
</tr>
<tr>
<td></td>
<td>Lot Size Reduction and SPF</td>
<td>Small Batches / Single Piece Flow / One Piece Flow</td>
</tr>
<tr>
<td></td>
<td>Value Analysis and Waste Elimination</td>
<td>Removal of 7 Wastes: a) Transportation b) Waiting c) Overproduction d) Defective Units e) Inventory f) Movement g) Excess Processing</td>
</tr>
<tr>
<td></td>
<td>Visual Management</td>
<td>Visual Control / Andon / Visualization / Visual System / Visual Communication</td>
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<tr>
<td></td>
<td>Equipment Layout and Materials Handling</td>
<td>Equipment Layout / Materials Handling / Plant Layout / Workplace Design</td>
</tr>
</tbody>
</table>

4.3. Development of the Conceptual Model

Based on the latent manifests and the manifest variables discussed above, the conceptual model thus developed for implementing LM in manufacturing industries is exhibited in Figure 1.
Figure 1. Conceptual Model for HR and Internal Practices towards Successful LM Implementation.

Conclusion

The variables that will affect the success rate of a lean manufacturing implementation are important to understand, but it is also important to realize how the organization may be impacted by the lean manufacturing implementation. A lean manufacturing implementation may not only provide economic benefits to the organization, but other less tangible benefits as well. A key example of such a benefit is increased communication. When communication does not occur, production and quality may suffer and resentment between workers may occur. Lean manufacturing requires clear communication between all value streams. All customer-supplier connections within the organization must have a direct connection and there must be a clear method for sending and receiving responses to problems. The characteristics of successful lean operations make a committed workforce a necessity. In order to make a strategic lean approach work, process operators have to work in process related teams, rather than their current functional ones. Teams need to become truly self-directed, allowing problems to pick the people required to solve them from within the teams rather than management picking the problems and assigning them to people to solve. This means starting with the tools but quickly realizing that Lean requires a change in thinking and managing. Most lean implementation failures are not due to failure to grasp the tools and techniques but a failure of change management.

This research is applicable primarily to the manufacturing sector and is expected to provide further insights for lean implementation. There are researches on lean implementation but this work is one of the very first researches to have a comprehensive study of the HR and internal practices for implementation of lean manufacturing. Piecemeal research studies have been done in the past but this study intends to bridge the gap and integrate all the parameters into a single comprehensive study, aimed at practical implementation of lean manufacturing. This is a notable and promising outcome of the current study, especially from a strategic viewpoint.

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