Global Journal of Management and Business Research: G Interdisciplinary
Volume 17 Issue 1 Version 1.0 Year 2017
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4588 & Print ISSN: 0975-5853

Identification of the Barriers in Implementation of Lean Principles in Iranian SMEs: Case Study Approach

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Abstract- The manufacturing sector is considered to be a cornerstone in the global economy through its influence on areas such as mining and construction in upstream and warehousing and transportation in downstream. Despite having a rich literature concerning the application of lean principles in the large companies, the number of studies related to SMEs is relatively limited and a lot of essential problems and areas are largely untouched in academic research. This paper aims to identify the main barriers in implementation of lean manufacturing principles in Iranian SMEs. In order to do so, case study approach was selected and 9 in-depth interviews were conducted in various industrial sectors such as electrical equipment, industrial machinery and automotive part supplier. As a result the main barriers were classified into four categories namely, lack of top management support, financial capability, lack of employee's skill and expertise and organizational culture. Accordingly a guideline was developed that can be adopted to address the aforementioned barriers and reduce their costs by adopting the lean principles.

Keywords: *Lean manufacturing, lean thinking, Iranian SMEs.*

GJMBR-G Classification: *JEL Code: L39*

Strictly as per the compliance and regulations of:

Identification of the Barriers in Implementation of Lean Principles in Iranian SMEs: Case Study Approach

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I. Introduction

The manufacturing sector has been playing a critical role in developing and advancing the world. This is evident as the developed countries such as USA, Germany and the UK, are planning to win back their manufacturing sectors from low cost countries (Moradlou and Backhouse 2016a; Moradlou et al. 2017). It is considered to be a cornerstone in the global economy through its influence on areas such as mining and construction in upstream and warehousing and transportation in downstream. This has resulted in various challenges to develop new approaches to maximize the production efficiency in terms of cost, quality of the products, required resources, environmental impacts and many others described by Liker (2004). The emphasis for perfection in manufacturing operations has been evolving throughout history. As the time passes, with the aid of advanced technologies, the lean manufacturing techniques have gained considerable popularity among the Iranian industries to boost productivity, effectiveness, responsiveness and the quality of the product. This is further emphasized as the Iranian industries are trying to attract foreign investment in manufacturing sector after the economic sanctions being removed in 2015 (Dyer and Bozorgmehr2016).

It is concluded from the available literature that the lean and techniques are theoretically applicable in all industries and has proven their success in practice specifically in large organizations (Rose et al., 2011). Despite having a rich literature about the applicability of the lean tools in large companies and the importance of these production philosophies in SMEs, it is evident that there is still a gap existing in the current knowledge to provide a classification of tools that enables the SMEs to adopt these two approaches. Due to the dearth in the available literature and the lack of emphasis within the industries, lean manufacturing concepts have not been widely introduced to the Iranian SMEs, hence the advantages of such production philosophies are not fully appreciated within the Iran's business environment. Consequently it can be seen that the number of manufacturing SMEs are gradually decreasing in the Iran's manufacturing sector regardless of their substantial influence in the overall economy of the country and being shifted to the countries that offer lower production costs similar to the off shoring trend in developed countries (Moradlou and Backhouse 2014; Moradlou and Backhouse 2016b).

One of the reasons behind this is that the SMEs are considered to be relatively vulnerable to the new entrants in the market therefore their market share can be easily replaced by other competitors. In addition the lean manufacturers at the head of supply chain tend to start the business with the suppliers who are capable of aligning their processes to comply with lean manufacturing. This is due to the lack of production strategies such as lean systems in the case of facing a turbulent business environment and inadequate knowledge about the lean principles for the cost reduction and effective production (Achanga et al., 2006).

II. Literature Review

The challenge for cost reduction in manufacturing sectors have prompted the majority of

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the companies regardless of the business size, to adopt the lean manufacturing system to boost their competitiveness in the intensified global market. According to Hogg (2008), lean is "a mindset, or way of thinking, with a commitment to achieve a totally waste-free operation that's focused on your customer's success. It is achieved by simplifying and continuously improving all processes and relationships in an environment of trust, respect and full employee involvement. It is about people, simplicity, flow, visibility, partnerships and true value as perceived by the customer". A comprehensive definition for the non-value added processes "wastes" was given by Russell & Taylor (1999) as follow: "anything other than the minimum amount of equipment materials, parts, space, and time that are essential to add value to the product".

According to Womack et al., (1990), the main objective in the implementation of lean techniques is to design a system with a smooth process, which enables the companies to manufacture world-class quality products and services to satisfy the customer demand while eliminating wastes. In order to achieve that, it is important for the companies to recognize the wastes associated with their manufacturing systems. To simplify this task, Shingo (1992) established the concept of seven deadly wastes. This identifies seven different categories of manufacturing wastes as follow: overproduction, over-processing, transportation, inventory, motion, defects and waiting time. Further indication was given by Ohno about the overproduction to be the most important waste among the other non-value added activities since it ultimately leads to excessive inventory in the operations downstream (Liker, 2004).

Womack et al., (1990) claimed that it is the employees that determine the level of leanness within the companies and they can be considered to be the heart of the lean organization. This emphasizes the importance of sharing the lean knowledge among the employees of all levels which results in their participation and contribution. This can ultimately result in lean culture within the organization, which is considered to be a crucial challenge for management (Worley & Doolen, 2006).

Despite having a rich literature concerning the application of lean principles in the large companies, the number of studies related to Iranian SMEs is relatively limited and a lot of essential problems and areas are largely untouched in academic research. Zhou (2012) has stated that the failure in implementation of the lean programs are due to the style of the management or people related factors as well as the key knowledge and know-how. Correspondingly Achanga et al., (2006) believes that there is a connection between management styles and the company outputs such as the lead-time, number of employees and the return on investments (ROIs). He argued that the main lean barriers are not tools and technologies, but the lack of appreciatiation and provisions from middle and senior management.This can be also found in the study done by Moradlou and Asadi (2015) where top management is one of the key reasons behind the management of SMEs in a fluctuating environment. This is while Salaheldin (2005) claims that the lack of skilled resources for implementing the lean practices is the main obstacle for SMEs to be lean. However Shah and Ward (2003) believe that the main obstacle in implementation of lean tools, is considered to be the size of the organization. This was further emphasized through particular suggestion that not all Just In Time (JIT) practices can be a suitable solution to be applied in SMEs (Shah & Ward, 2003). Cusumano (1994) also studied the feasibility of the lean implementation in SMEs but in his studies, he concluded that the product variety could be the major consideration that leads to an unsuccessful lean implementation for any company (Cusumano, 1994)

III. Methodology

For the purpose of this investigation, qualitative data collection method was nominated since this technique offers a range of benefits in this instance (Klein & Myers, 1999). These types of research enable to gather in depth information about the human behavior and their justifications. It also determines the reason behind any decision-making (why and how) as well as the time and location of each decision. Therefore one of the advantages of qualitative research is that it allows discovering the reason for any failure or success in implementation of lean programs. Another advantage of this technique is its flexibility according to the types of the industries being studied (Patton, 1990).It should be noted that according to Akhoondi & Morshedi (2012) the companies having less than 100 employees fall into the SME category in Iran whereas this number is different in other countries.

In order to undertake the interviews, an open-ended questionnaire was used in 9 different companies in Iran. Table 1 provides the demographic information of the companies that were visited and interviewed. This approach has been recommended by various authors such asRibeiro &Fernandes(2009) and Powella et al., (2013) who have carried out similar studies to this investigation. Planning an exploratory interview questions can only be achieved after obtaining a good understanding of the recent literature about the lean techniques and the relevant tools that supports their objectives. It is also essential to discover their functionalities within different industries (electronic, food, etc.), meanwhile to gather adequate knowledge about the Small and Medium Enterprises in Iran. For the purpose of this investigation the interview questions contains only basic terms. It was found that the SMEs

tend to have limited knowledge about the technical terms used in the lean manufacturing principles. Therefore to minimize the misinterpretations the generalized questions were asked to cover wider areas and the results were then extracted from the recorded or written documents during the interviews. The data gathering addresses the questions about the lean techniques and how the companies approach the design changes and respond to the demand fluctuation. It also questions to what extent the companies manufacture customized product and the possible barriers in implementation of lean manufacturing.

Table 1: Company Demographics

Sector	Firm	Number of employees	Informant position
Electrical Equipment	Manufacturer 1	105	Supply Chain Manager
	Manufacturer 2	90	Supply Chain Manager
	Manufacturer 3	56	Managing Director
Industrial Machinery	Manufacturer 4	80	Supply Chain Manager
	Manufacturer 5	50	Managing Director
	Manufacturer 6	35	Managing Director
	Manufacturer 7	42	Managing Director
Automotive Part Supplier	Manufacturer 8	70	Sales and Marketing Manager
	Manufacturer 9	25	Managing Director

IV. Findings

After performing a qualitative data analysis based on interviews and visiting 9 different organizations in Iran, the following observations were drawn to provide an in-depth understanding of the barriers in implementation of lean programs in Iranian SMEs and to facilitate the identification of a general solution for companies to adopt lean principles. Hence, in order to analyze the interviews it is essential to assess the company's level of understanding about the lean principles. One way to do this is to question the number of years that these companies have employed lean practices within their systems. As a result, the targeted companies were divided into two categories. The first category was the companies that had no previous knowledge about the lean techniques therefore did not have any desire on implementation of lean programs. These companies appeared to have a limited understanding of any tangible and intangible advantages gained by lean production. The results show that only four companies out of the nine companies could be allocated in this category. The second category was the organizations that have established a clear understanding of the lean concept or have already attempted on adopting the principles to reduce their production cost and improve their line efficiency. This category consists of mainly the medium sized enterprises due to the size of the organization and the importance of maintaining a low cost production. Consequently the remaining five companies were included in the second classification, which represent the majority of the companies selected for the purpose of this investigation. The result shows that the medium size companies visited, have all taken the first steps towards development of leanness however they have experienced a range of barriers in different aspects.

According to the results obtained, the second categories of companies described above, adopt lean principles due to variety of reasons. The most important factor, which was shared by almost all of the companies, was the reduction in cost to improve the profit margin. Other factors such as improvement in space utilization in the factory, improvement in the product quality, reduction in lead-time, reduction in the manpower required, improvement in the competitive position within the market, reduction in the inventory and improvement of the collaboration with their suppliers were also taken into account.

After accomplishing nine interviews from different industries, the reasons for the failure in implementation of the lean practices in Iran were classified into four fundamental categories which appear to be consistent with the research available in the literature suggested by the researchers such as Achanga et. al., (2006) and Zhou (2012). Figure 1 highlights these four reasons which are the lack of top management support for implementing lean programs, financial capabilities of the organisation, skills and expertise of the employees and finally the culture of the organisations that plan to implement the lean practice.

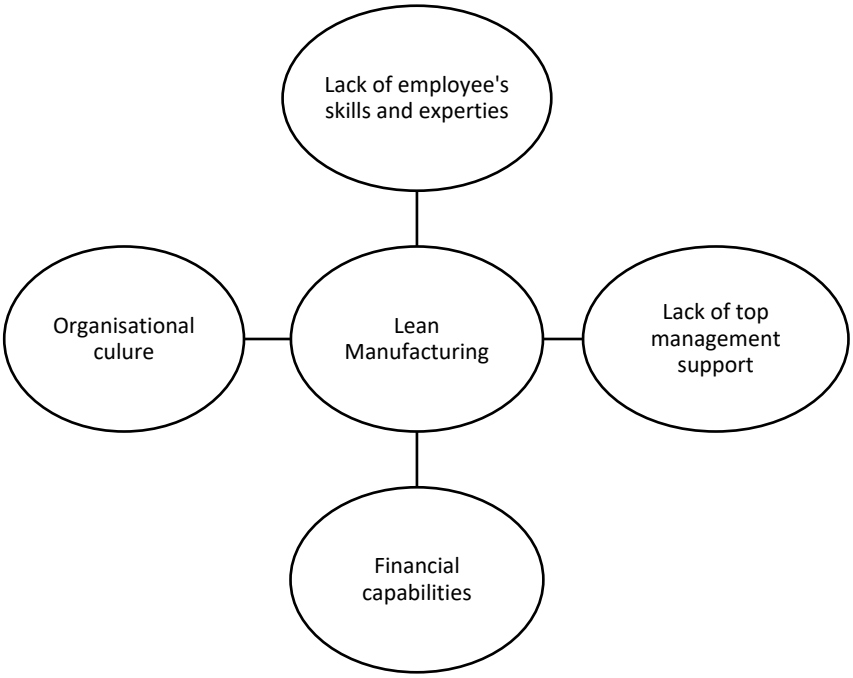

Figure 1: Main barriers in implementation of lean manufacturing in Iranian SMEs

a) Lack of top management support

Management contribution and provision is considered to be one of the biggest challenges in successful implementation of lean practises. A large number of SMEs fail to achieve lean objectives due to the lack of providing approperiate support and foundation for lean programs. One of the major tasks that the manegers do not perceive as one of their core responsibilities, is the encouragement for employee participation. In other words, members of the organisation were not involved in the improvement of the processes. This was observed as one of the managers stated:

"*In our company the decision making processes are carried out among the top managers and then are introduced to the line personnel*" (Manufacturer 3)

According to the interviews, seven companies experienced the fact that their production managers did not establish a clear communication with the employees to introduce the vision and the strategy of their production. Therefore there was a lack of commitment on training other members of the organisation to enhence the skills and experties among the workforce. Due to the nature of lean principles, continues improvement in production processes is required to be achieved by the managers in order to prevent backsliding to the old ways of operation.

b) Financial capabilities

Another critical obstacle in the implementation of lean principles is found to be the financial and resource constraints that SMEs face when investing in lean programs. This ultimately prohibits the companies to hire their ideal management team and consultant for the training required for lean practices and leads to a poor system implementation. This is due to the nature of the small and medium size companies (number of employees and annual turnover). It should be noted that the lean manufacturing tools require company's financial capabilities. In order to support the system and its activities, every company is required to dedicate the implementation cost. Moreover there is a substantial variation in capital required according to the purpose of each tool. In addition to the capital required for each tool, there is a cost for the consultancy and training. The reason behind this is that the majority of small companies are incapable of transforming their organization towards leanness and require external consultants who can provide the necessary knowledge about different techniques and educate their employees.

Another factor related to the finance was discovered to be the resistance of the companies towards dedicating extra capital on process improvement. This was observed when six interviewees stated that they could not afford the cost of implementing lean tools in specific occasions such as long-term strategies and they would prefer to focus on cost saving activities rather than any other additional costs on processes. In addition to this, three companies believed that any cost dedicated to training and consultancy is considered to be loss of resources and can be used for alternative purposes such as purchase of raw material. The following quotation is from a managing director:

"*We already have high demand for our products and we don't see the necessity for further training, so any extra capital we get are spent on buying the material required for our production*" (Manufacturer 7)

c) Employee's skills and experties

Due to the financial incapability, it was found that all the targeted companies in this investigation have a tendency to employ highly skilled yet cost efficient personnel. Consequently these employees do not have sufficient background about lean principles. Therefore this is considered to be a hindrance to the implementation of competitive technologies for improving productivity and flexibility. This appeared as the small companies intend to carry on with the traditional production method as long as they can sustain their businesses.

It was also observed that one of the most critical triggers in unsuccessful lean programs is the lack of training, education and technical knowledge. In other words being unable to provide the appropriate form of training for each and every one in order for them to be able to do their job properly (Shibani et al., 2012). This fact would create obstacles, which prevents the development of lean programs. It was found that these barriers emerge in different formats. The first problem can appear in terms of inadequate knowledge about the lean in employees resulting in confusion on the program and not fully acknowledging the benefits. This ultimately contributes to the employee resistance since they are not directly involved in the planning and implementation phases of leanness (Haupt & Whiteman, 2004). Therefore lack of training has a substantial influence on the participation of the employees in decision-making.

"*According to my experience as a line manager in this company, the new employees come with limited background about lean tools therefore it requires a substantial effort to teach them what lean actually means and what its benefits are*" (Manufacturer 1)

Another issue caused by inadequate training was observed in terms of absence of work discipline. This is due to the inappropriate division of the tasks in the organization, which determines the contribution of the employees to the lean program. Since the implementation of the lean principles should be carried out in a team, it is important to keep the team members motivated by introducing the benefits of the program and clearly defining the aims and objectives of the lean methodology. So the employees are familiarized with the lean concept, which leads to further collaboration of team members.

d) Organisation culture

The establishment of an appropriate organizational culture is another crucial element in lean implementation. This provides a suitable platform for a better collaboration in a diverse environment. This enhances the importance of the management roles in overcoming the conflicts in organizations. The responses from the interviews emphasize that it is important to understand people growing up in different environment and background would ultimately have different cultures. This is also considered to be another potential factor caused by insufficient training, which leads to the failure in lean implementation since it determines the way people deal with the conflicts. The resistance to changes would be substantial if there is particularly deep-seated culture (Ngowi, 2000). The provision of insufficient training and uncertainty about the lean benefits can have a demotivating outcome on the members of the organizations. This is also supported by other researchers such as Achanga et al., (2006) who have also suggested that the absence of an appropriate organizational culture have negative effects such as employee resistance to changes and lack of focus on their long-term roles.

e) Guideline for implementing lean principles

In order to promote the lean thinking within an organization and fully employ the lean techniques, companies are required to under goa significant cultural transformation which can be achieved over the years. But there are number of critical success factors that should be adopted to facilitate the lean implementations in short term. This study attempts to address the main reasons that the SMEs in Iran fail to adopt lean manufacturing techniques and emphaseson the key criteria to establish a suitable platform for leanness. In this section of the paper, a series of recommendations are included as a guideline for the industries to remain competitive and healthy in the business by applying lean tools. According to the literature, the SMEs are incapable of applying all the techniques at the same time therefore they are recommended to approach sequentially in order to avoid any difficulties in terms of finance and employee's commitments (Rose et al., 2011). As a result of this investigation, the outcome can be classified into two categories. The first category emphasizes on providing a suitable environment to accelerate the productivity, efficiency and the quality improvement in products and services while the second category includes a set of tools that are the most feasible to be applied in SMEs.

f) Creating a lean environment

As it was mentioned before, despite the fact that the top management plays an important role in implementation of the lean principles, the entire population of the organization should undertake the responsibility of participation and commitment to their tasks. These responsibilities are for all the members of the organization from the line personnel such as the technicians, operators and shop floor workers to the vice presidents and senior manager. Hence the lean culture is a vital element of leanness and is considered to be the most challenging task in initial phases of lean implementation (Zhou, 2012).

Cultural changes take time; it cannot be accomplished overnight or in a few weeks. In order to prevent the risk of the failures in the lean

implementation, two approaches are suggested to provide the essential background about the program and it's applications in the organization and train the team for the continues improvement. The first method is the formal training. This can be achieved by commissioning a leading consulting group that can educate the managing directors and teach them the key elements in execution of the lean programs. Their knowledge can ultimately be used to provide the sufficient technical material for the rest of the organization. This method tends to be an easy solution in the small organizations since it has fewer layers of management and staff (Ghobadian & Gallear 2001). However this can be a great disadvantage for the small companies in term of the significant requirement for financial support. An alternative approach for training is the informal guidance. One way to achieve this is to display information about lean tools on the company's bulletin board. This information can be gradually observed by the members of organisations since it is always available and can be easily updated every month. The training provided by the organisations can take two forms. In the first method the principle of the lean manufacturing and training are delivered. This can familiarise the team members with the concept of leanness. Then further training can be subjected in terms of preparation exercise for the members to face and address the problems by adopting lean tools and techniques. To do so, examples from real life problems can be introduced (Kassicieh & Yourstone, 1998; Amar & Zain , 2002).

As a result of the training methodologies mentioned above, the organisation members would be encouraged to undertake more responsibilities, develop their creativity skills, be innovative, improve their communication skills and work effective. According to Tenner and DeToro (1992) "Education and training provides the knowledge needed on the mission, vision, direction, and strategy of the organization as well as the skill need to secure quality improvement and resolve problems".

As part of the management responsibilities and cultural platform, it is important to ensure a no-blame environment within the company. In such an environment the mistakes are approached as an opportunity to learn more about the elimination of the potential causes. This is achieved by establishing a close relationship between the managers and the workers. It is important to have in mind that the mistake can frequently occur and are part of the facts in all employees work life. Hence in the case of any failure in the processes, pointing at people should be avoided. Managers should also ensure a regular conversation with the employees involving questioning, listening, observing and judging, to boost their self-esteem. This is done by arranging regular meetings to allow people to share their assignments and achievements. In order to ensure an effective participation in every meeting, firstly the aims and objectives of that meeting should be clearly communicated and then the time frame and agenda should be mutually agreed with other members of the organization. Moreover after every meeting a summary of activities that are required to be carried out until the next meeting can be obtained highlighting critical tasks.

Another key element that needs to be considered is to provide a clear vision when starting any process improvement program. According to Covey (1989), to establish an understandable vision, the following characteristics should be taken into account. It should

- Be instigated by the managers
- Be inpiring and positive to motivate the team members
- Include adequate level of details and be easy to understand
- Be shared among the group members
- Be concise and easy to remember

After adopting a suitable management style and organizational culture, the next task is to select the feasible tools and techniques that can be applied in SMEs regardless of their size and financial capabilities, which is included in the following section.

g) Applicable lean tools in SMEs

Due to the limited budget available within SMEs, these companies are cautious in the investments regarding the productivity, efficacy and quality improvement programs. This has reduced the range of tools available for the SMEs. In this section of the paper some tools are recommended as feasible examples to be applied in Iranian SMEs that are already in operation. This can encompass the factory layout design process. Layout design process for a production line involves determination of the physical relationship between workstations or equipment and identification of the tasks, which need to be allocated in each of them (Arostegui et al., 2006). Thus it is an essential task to define a close relationship between product design, process design, schedule design and layout design while designing a factory plant. Therefore this allows obtaining the optimum design, which would minimize the material handling cost and time. At present different types of layout designs can be adopted in production lines according to nature of the production. In other words these layouts are selected or combined as a hybrid layouts based on system characteristics such as production volume and product mix. These layouts are fixed position layout, functional layout (job shop and process layout), cell layout (group technology) and product layout, which is also called flow shop layout (Askin &Standridge, 1993). Note that by this stage, some of the most essential lean tools should be applied

as part of factory layout design. For instance, tools such as cell layout pull system, Kanban systems, one-piece flow and poka-yoke can be taken into account from the early stages of designs. Once the mentioned considerations are taken into account the following recommendations can be applied in an already operating organization to increase the production efficiencies, productivity and quality.

As a suggestion for initial step towards leanness, one would recommend the lean consideration during the product design stage. According to the National Research Council Canada (2004), the consideration of lean principles at product design stage can reduce the problems caused during the production up to 92%. In order to do so, firstly the designers should attempt to minimize the complexity of the product in order to reduce the waste created in manufacturing stage. Another important step towards leanness is to standardize the components used in the products to ensure the reusability of the parts in different products. This strategy can be also employed in system architecture and factory layout design to allow mass customization downstream of the production. It is also important to build the quality in products during the design phase. One method used for this is six-sigma methodology.

After applying the lean principles in the design phase, various lean tools can be recommended according to their purpose. Note that these recommendations are based on the existing literature and data collected during the interviews. It appears that some of these tools have already been applied within the case studies selected in this investigation (medium size companies) and have proven to be successful such as work place organization 5S systems and process mapping. It was found that the 5S system is the most suitable tool to be applied in SMEs as a starting point in lean programs. However according to the literature, mapping the value stream is considered to be the primary tool to be used (National Research Council Canada, 2004). The reason for employing the 5S prior to the value stream mapping is due to the simplicity and the low investment required for its application. This ultimately provides a clean and standardized environment within the company in which the non-value adding activities can be easily identified and eliminated. After applying 5S systems to a satisfactory level, value stream mapping can be initiated. This tool allows the company to develop a clear image of the value stream and identifies the potential bottlenecks that are likely to occur within the processes. This can be achieved using various methods such as the process activity mapping, supply chain response matrix, production variety funnel, quality filter mapping, demand amplification mapping, decision point analysis, and physical structure volume and value (Taylor & Brunt, 2001).

Consequently the non-value adding activities are identified. This can also be achieved using quality circle, which is a group of employees that work together under the supervision of their leader to identify and solve the issues related to the manufacturing processes and report them to the organisation management to overcome and improve the production performance. One of the non-value adding activities, which were found to be the most common among the visited companies, was the excessive material handling and the set up time. In order to reduce such inefficiencies, it is important to list every set up required during the production and measure the times spent on each of them. Moreover the external and internal setup times should be identified. After doing so, the internal setups can be converted to external ones. The overall reduction can be illustrated using the setup reduction graph, which compares the result before and after applying the setup time reduction tool.

Another critical aspect in lean manufacturing is the ergonomic and the health and safety of the workplace. The principal aim of the ergonomic is to provide a suitable condition for the staff in their working environment. This would depend on the characteristics of the employees and the area that they work in. Therefore in any of workstation within the production line, it is important to ensure that any unnecessary movements are prevented by keeping the handling range as short as possible. This would result in increase in productivity of the employees since it avoids fatigue in the work place (ITEM, 2010).

V. Conclusion

This investigation was undertaken to assess the applicability of the lean manufacturing techniques within Iranian SMEs and identify the potential barriers for implementation of these tools. The findings suggest that in general, the lean manufacturing tools are not fully developed within SMEs in Iran. Hence there were number of obstacles identified towards leanness of the organisations. The following conclusions can be drawn from the present study.

This study shows that the barriers to implementation of lean program can be classified into four categories. These categories are lack of top management support, financial capabilities, employee skills and expertise and organisational culture. After identifying these barriers, a reasonable approach was then developed to address these obstacles. The finding of this research suggests that the lean implementation can be achieved in two stages. The first set of recommendations is to provide an appropriate lean environment in the organization. In order to do so the managers are responsible to educate every members of the organization about the concept of lean manufacturing by providing formal and informal training.

In addition as part of the management responsibilities and cultural platform, it is important to ensure a no-blame environment in which the mistakes are approached as an opportunity to learn more about the elimination of the potential causes. Another step towards a lean environment is to arrange regular meetings to discuss the new ideas and provide a clear vision. In the second set of recommendations, a range of feasible tools were suggested. The first step was to integrate lean principles in product design phase eliminating potential wastes. This was followed by the consideration of cell manufacturing, pull system, Kanban systems, one-piece flow and poke-yoke methodologies in factory layout design stage. Subsequently, tools such as 5S, value stream mapping, quality circle, work place ergonomic and health and safety can be applied once the company is about to start the production.

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