

The Status of Lean Manufacturing Initiatives in the UK Small and Medium-Sized Enterprises – A Survey

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ABSTRACT

The importance of Small and Medium-sized Enterprises (SMEs) in The United Kingdom (UK) cannot be over-emphasised, as they have been playing a very prominent role in the growth of the country's economy. Often regarded as the core of manufacturing in the UK, the SMEs have in recent years been bedevilled with barrage of problems which were attributed to their traditional system of manufacturing which involves a lot of waste. Some of these problems facing them include stiff competition, low quality of products, as well as loss of market share. To this end, the companies began to question their manufacturing method, in a bid to identify the merits and demerits it has over other systems of manufacturing, especially the type been practiced by the Japanese whose products are not only of higher quality, but also affordable. The search led to their adoption of Lean Production System (LPS), which has many advantages over mass and craft systems of manufacturing. Questionnaires and semi-structured interviews were employed for the survey in order to obtain a well-balanced result, and were targeted at the manufacturing SMEs in the automobile, aerospace, electronics and the plastics industries in the UK. The application of SPSS and Microsoft Excel software for the analysis showed that the current status of LPS in the UK SMEs is not very impressive, as although there are many improvements which are far better than what could be achieved with any other system of manufacturing, the companies have not really achieved much in terms of waste reduction and financial benefits. These could be attributed to the recent history of LPS implementation, as well as the limited knowledge the firms have on the LPS tools and techniques, especially as it regards to their inability to implement all of them harmoniously.

Keywords: Lean production system, Small and medium-sized enterprises, questionnaires, semi structured interviews, just-in-time, five s, single minute exchange of dies, lead time, throughput.

1. INTRODUCTION

The UK Department of Trade and Industry (DTI) explained on its webpage that a medium sized company must satisfy not less than two of the following criteria:

- An annual turnover of not more than 22.8 million pounds;
- A balance sheet total of not more than 11.4 million pounds;
- Not more than 250 employees.

Based on the above, a Small and Medium sized Enterprise can then be defined as a company or organisation whose turnover does not exceed 22.8 million pounds and whose number of employees is not more than 250.

In her study Hillary (2000) noted that the SMEs apart from being the bedrock of the future businesses are the source of creativity as well as competition. She maintained that 99.8 percent of businesses in UK are SMEs who contribute their meaningful quota to the development of the country's economy, by harnessing the innovative efforts of individuals and also make a substantial contribution to the country's gross domestic product.

This explains the need to assess the status of Lean Production System in the manufacturing sector of the UK SMEs, this is because LPS has been adjudged the world's best practice in manufacturing.

According to Treville and Antonakis (2006) Lean Production System (LPS) is "an integrated manufacturing system that is intended to maximize the capacity utilization and minimize the buffer inventories of a given operation through minimizing system variability (related to arrival rates, processing times, and process conformance to specifications)." It is also a manufacturing approach and technique that is applied to achieve continuous improvement through the identification and elimination of wastes.

Shultz (2005) pointed out that Lean Enterprise Institute (LEI) defined LPS as "a business system for organizing and managing product development, operations, suppliers, and customer relations that requires less human effort, less space, less capital, and less time to make products with fewer defects to precise customer desires, compared with the previous system of mass production."

The whole concept of LPS is aimed at using little resources to achieve more, as well as increasing the quality of manufactured products, lessen lead times, reduce costs and also increase manufacturing flexibility. Dennis (2002) explained that Lean Production System means achieving more benefits with little – smaller amount of time, fewer materials, fewer efforts from employees, as well as less space – while ensuring that the customer's requirements are met.

Apart from the use of fewer resources for manufacturing, LPS is also aimed at the production of highly reliable products in a very conducive workplace. According to Reisman and Burns (2006) LPS was able to achieve "it's magic by introducing new production and operational processes that improved organizational productivity. In the case of manufacturing, this resulted in reduced inventory, increased throughput and improved customer service levels." They maintained that LPS also "stressed lasting, collaborative relationships with suppliers and business partners."

The whole essence of LPS is targeted towards fast manufacturing of high quality products in an ever improving company. Womack, Jones, and Roos (1990) explained that Lean Production System "uses the less of everything compared with mass production – half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time." To achieve these, LPS is therefore targeted at detection, isolation and elimination of all possible wastes in manufacturing through continuous improvement.

According to Hines (1994) the role of LPS is to eliminate all the manufacturing activities that do not add value to the product and to also reduce the overall throughput of the product. He listed its main elements as the management of "processes and the integrated logistics flow, relationship with employees, teams and suppliers, and the change from traditional mass production."

Turner and Parry (2003) noted that the principles of LPS states that all wastes in manufacturing processes must be eliminated which include processes of accounting and design as well as the supply chain. They maintained that a company cannot claim to be Lean until it takes a holistic view of LPS. As could be observed from figure 1, unlike the traditional system of manufacturing that focuses on the addition of people and machineries to the shop floor, and also ensuring that they work longer, faster and harder, LPS is geared towards eliminating all the waste in manufacturing as well as improving the value stream.

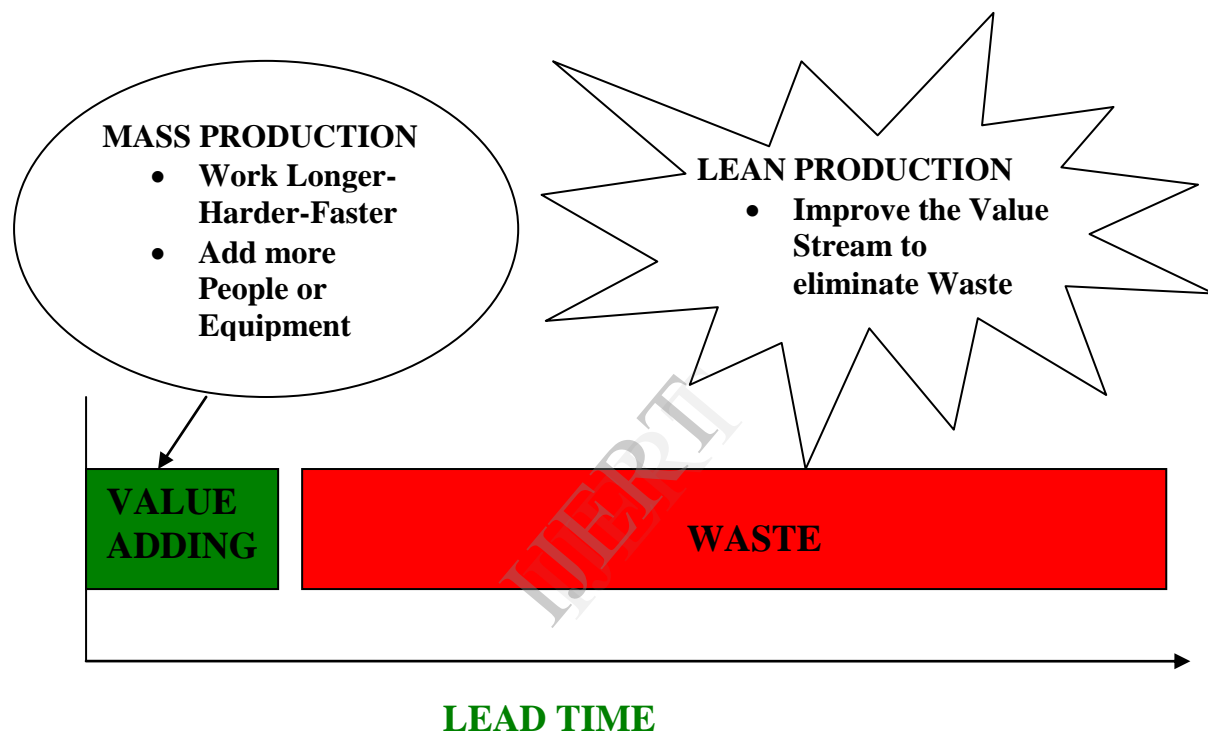


Fig. 1: Waste elimination – LPS versus Traditional approach (Source: <http://www.beyondlean.com/history-of-lean.html>)

This survey work is aimed at assessing the status of lean production system in the UK small and medium-sized enterprises. The following results and analysis are based on the comments of the respondents from questionnaires and semi-structured interviews.

2. MATERIALS AND METHODS

A total of 300 questionnaires were sent out by post to some of the manufacturing companies in the UK for the survey, out of which 50 responses were received back. The response rate is considered to be reasonable as it is nearly 17% of the total questionnaires.

Out of the 50 respondents, 8 of them were blank, 1 of them stated that the company had already been closed down, 2 declined to participate in the survey, 15 could not complete the questionnaire, as they explained that they were not implementing LPS in their organisations, while 24 or 48% of the companies are actually practising the manufacturing method.

3. RESULTS AND DISCUSSIONS

The questionnaires were targeted at the manufacturing SMEs in the automobile, aerospace, electronics and the plastics industries here in UK, as many of them have been implementing and reaping the many benefits of LPS for quite some time. It was observed from the returned questionnaires that only few respondents answered the open-ended questions unlike the close-ended ones that were fully answered by the majority of the respondents.

The following results and analyses are based on the answers provided by the respondents.

Some of the reasons given by some of the UK SMEs for not implementing LPS in their organisations include the following:

- No time/manpower to implement LPS;
- Insufficient volume yet to justify the investment needed, will become Lean when volume justifies it;
- Don't know what it is;
- Mass production;
- Do not manufacture; and
- Not applicable.

Based on the responses received from the 39 companies that are either implementing or not implementing LPS, it was realised as shown in figure 2 that the industry area of 6 of them is Mechanical, 12 in automotive and 2 in aerospace. Also 3 of the companies are in electronics, and 6 in plastics, while 13 companies are in other industrial sectors. The survey result showed that 3 of the companies have 2 industry areas each. The other industrial sectors of the companies are chemicals, metals, mountain bike, steel, and oil and gas.

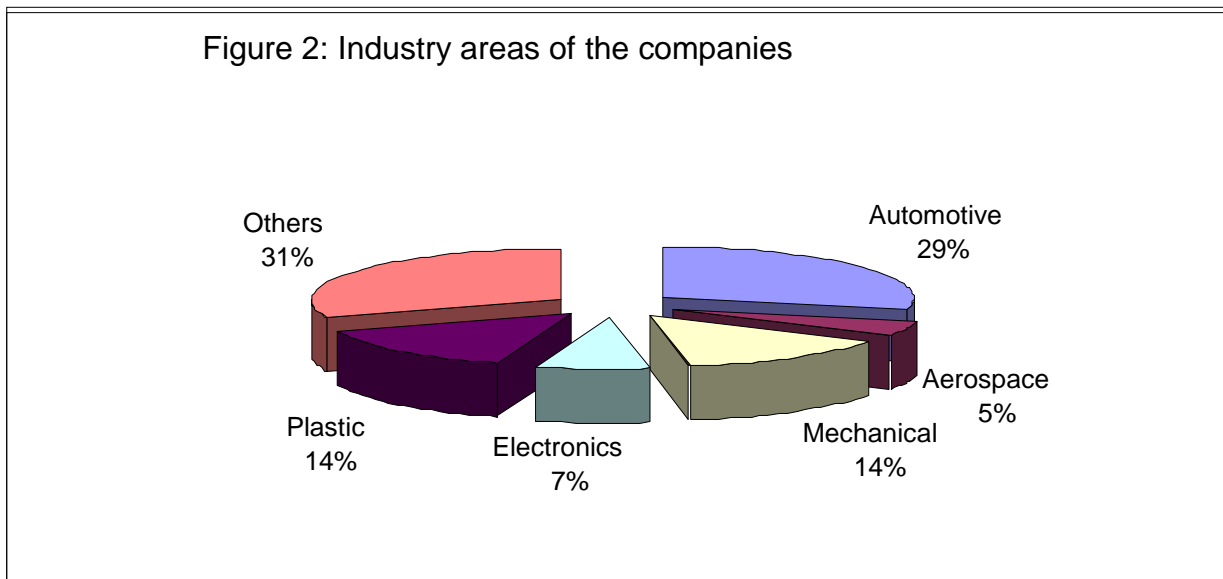
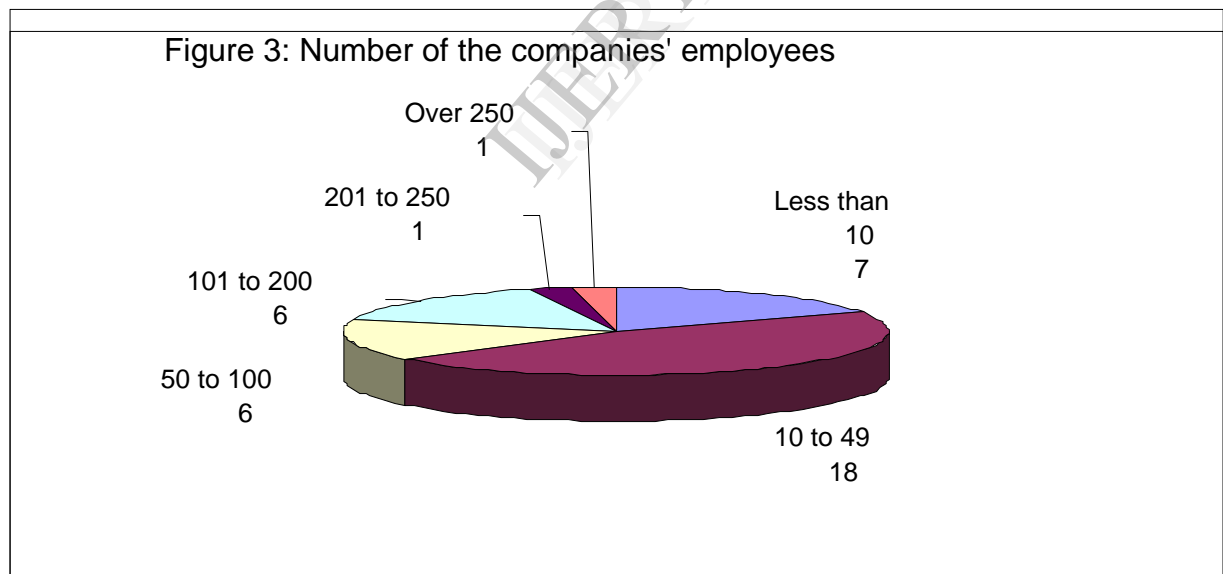
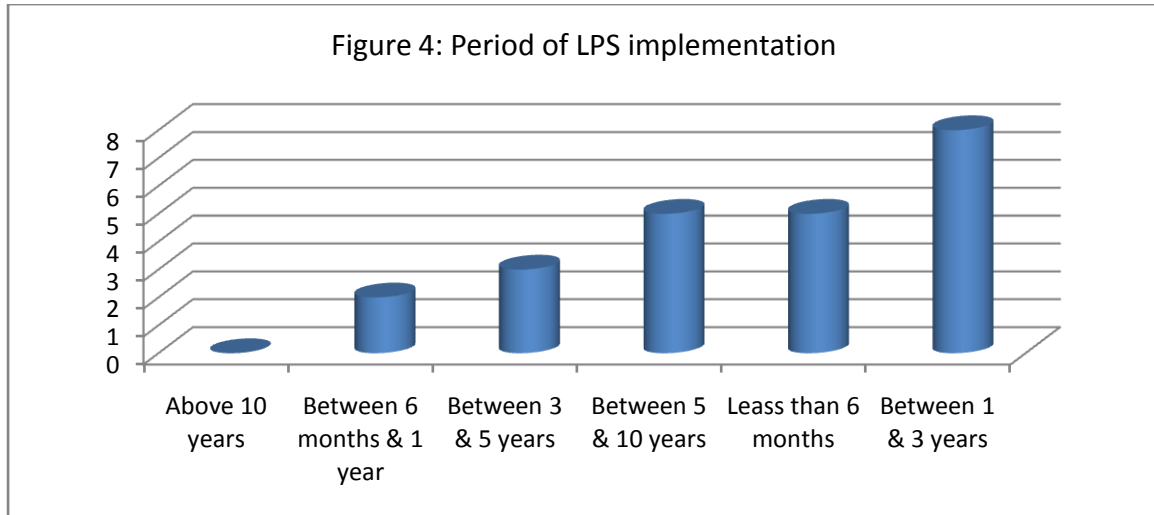


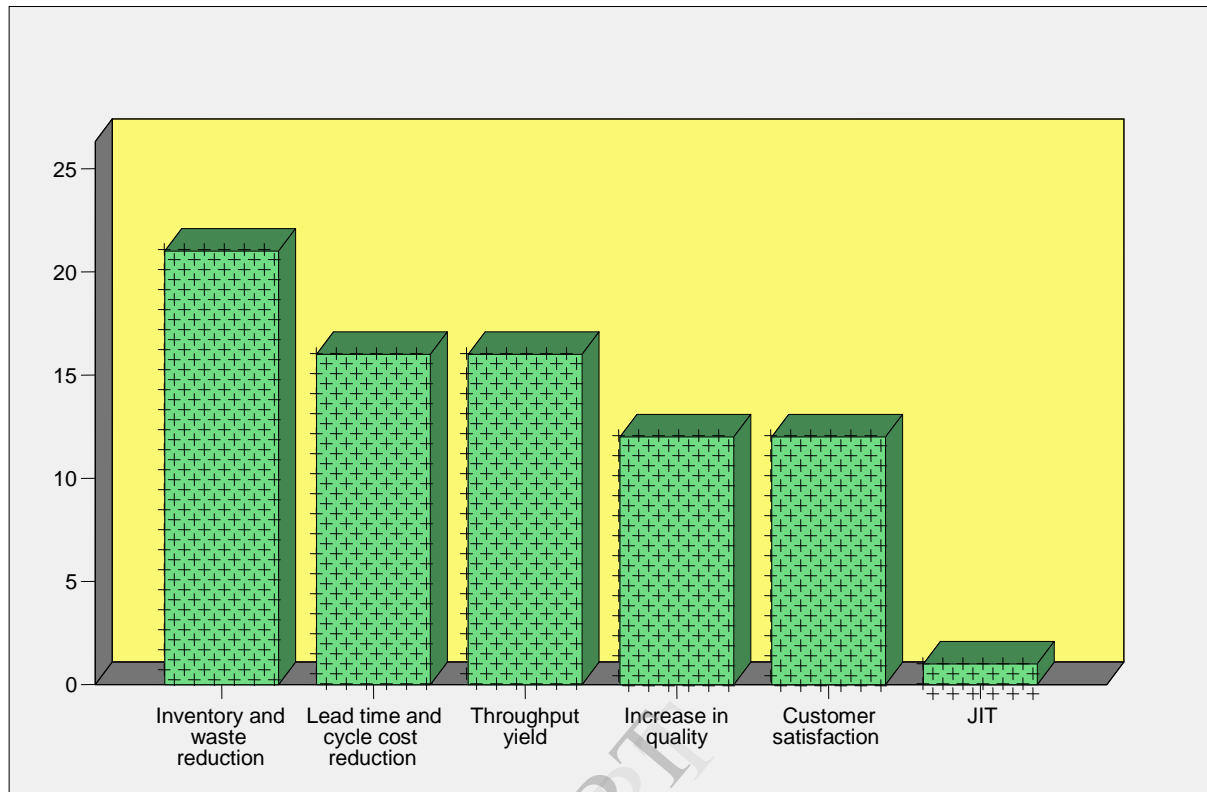
Figure 3 shows the proportion of the surveyed companies as regards to the number of their employees.



The survey also revealed the implementation period of LPS in UK SMEs. Interestingly as shown in figure 4, all the participating companies have a recent history of LPS implementation, as the introduction of the manufacturing method in their various companies have not exceeded 10 years.

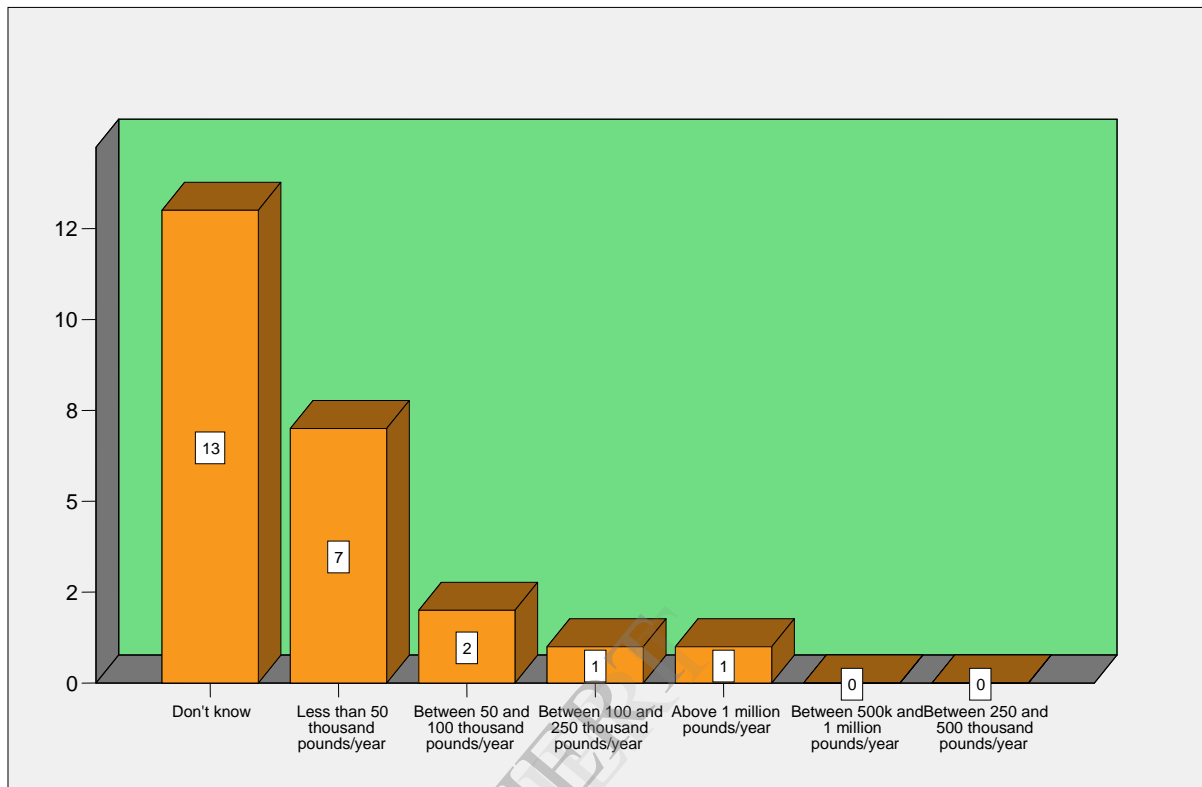


It was realised that the participating companies were not using just one measure to appraise the performance of LPS in their establishments, but were rather using two or more. As shown in figure 5, the most widely used measure is inventory and waste reduction, followed by the reduction of lead time and cycle cost. However, one of the respondents pointed out that his company is also using Just-In-Time (which is based on its ability to provide its product to the customer when and where it is needed) to measure its LPS performance.

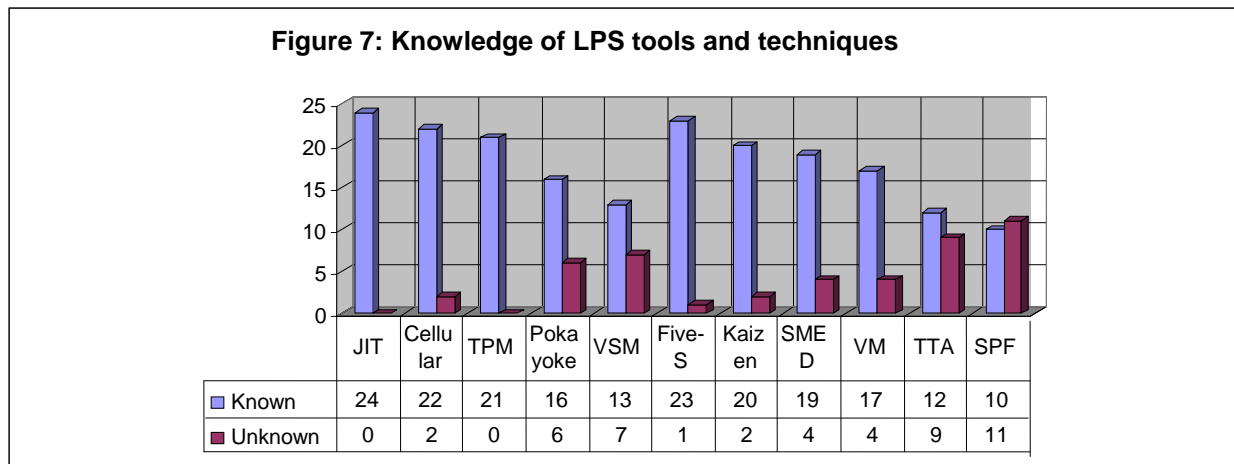
Figure 5: LPS performance measures

The research indicated that 67% of the 24 LPS implementing companies involve all the members of their firms in the implementation of the manufacturing method, 29% of them were not, while one of the companies did not provide an answer to the question. On the issue of recommending LPS to other manufacturers, 23 of the companies responded on the affirmative, while one of them stated that it is not sure if it will, pointing out that the manufacturing approach is not meant for everyone.

From figure 6, it can be observed that 54% of the respondents were reluctant to mention the financial benefits their organisation has gained from implementing LPS, as they selected a 'Don't know' option. However, 29% of the respondents pointed out that their financial benefits for implementing LPS were less than 50 thousand pounds each year, while just one company stated that its financial benefits were in the excess of 1 million pounds.

Figure 6: Financial benefits of LPS implementation

Another interesting factor that was analysed was the knowledge of tools and techniques of Lean Production System. As shown in figure 7, all the 24 manufacturing companies in the survey are not aware of all the tools and techniques of LPS, only 13 companies know about Value Stream Mapping, while 6 of them are ignorant of the important tool. However, due to its popularity, Just-in-time (JIT) was the only LPS tool and technique that is known by all the respondents.

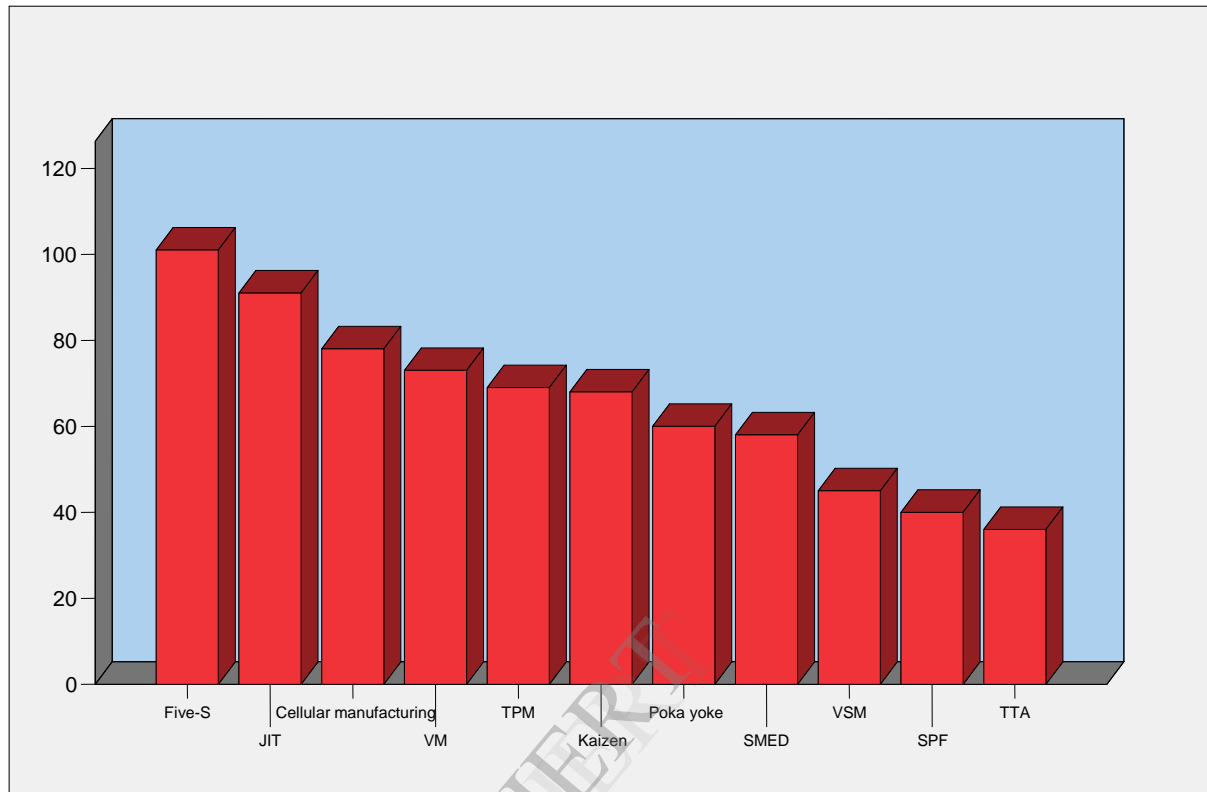


To effectively analyse the usage and usefulness of the various LPS tools and techniques from, the following scales as shown in table 1 were chosen for the different options.

Table 1: Scale for the analyses of usage and usefulness of LPS tools and techniques

USAGE	SCALE	USEFULNESS	SCALE
Never been used	1	Not useful	1
Used only once	2	Slightly useful	2
Used rarely	3	Useful	3
Used frequently	4	Very useful	4
Used continuously	5	Extremely useful	5

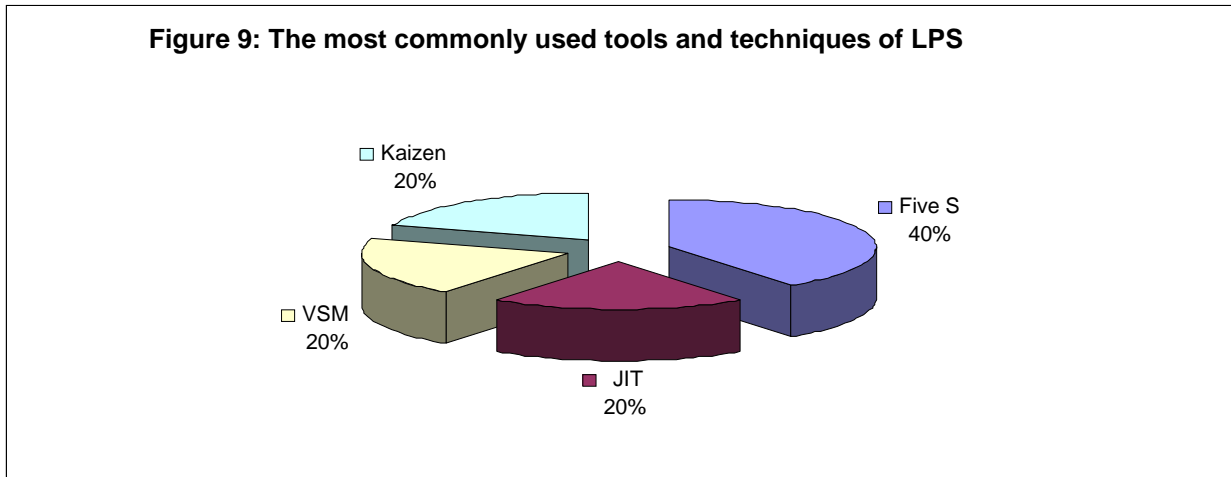
Based on the scale, the maximum point for each tool is 5, bringing it to a total of 120 points for each tool, as a result of the 24 respondents. As shown below in figure 8, the analysis of the results revealed that Five S is the most frequently used tool, as it has the highest points of 101, while Takt Time Analysis is the least frequently used tool by the UK SMEs.

Figure 8: Usage of the tools and techniques of LPS

The survey also produced an interesting result for the usefulness of LPS tools and techniques in the UK SMEs. 'Five S practice' with a total of 102 points was also identified by the respondents as the most useful tool in the implementation of LPS, followed by JIT, Visual management, Kaizen, Cellular Manufacturing, Single Minute Exchange of Dies (SMED), Total Production Maintenance (TPM), Poka Yoke, Visual Stream Management, and Single Piece Flow, while Takt Time Analysis was isolated as the least useful LPS tool and technique.

In terms of the type of change management tool being implemented by the UK SMEs, only 9 companies responded to the question as it was open-ended. 2 of the respondents identified training as the change management tool they are implementing, while the other two identified LPS. Four other companies pointed out that standard form, employee's 100% participation, Kaizen and communication/teamwork is their change management tool respectively, while the other company explained that change management tool is not applicable to it.

Also an open-ended question, only 10 respondents provided answers to the most commonly used tools and techniques of LPS. As shown below in figure 9, the result which is in tandem with the usage and usefulness of the tools and techniques revealed that Five S is the most commonly used tool by the UK manufacturing SMEs that are implementing LPS.



The result gotten from the least commonly used tools and techniques of LPS could be treated with caution as only 8 companies responded to the question with each of them identifying a completely different tool. The tools and techniques listed by the respondents include Takt Time Analysis, Poka Yoke, Cellular Manufacturing, Value Stream Mapping, and surprisingly JIT.

To analyse the third section of the questionnaire which was based on the critical success factors of implementing LPS, a minimum scale of 1 is chosen for not important and a maximum of 5 for crucial as shown in table 2.

Table 2: Scale for the analyses of tools and techniques of LPS

OPTION	POINT
Not important	1
Less important	2
Important	3
Very important	4
Crucial	5

Based on the maximum of 5 points, the 4 sub factors for each critical success factor, and the 24 respondents, each factor has a maximum of 480 points. From the analysis, Management Leadership Involvement and participation was identified by the companies as the most crucial success factor of implementing LPS, followed by Skills and expertise, Customers, Organisational Infrastructure, Finance, Others, Suppliers, Education and Training, while cultural change had the minimum points and therefore is the least critical success factor. The factors labelled as 'others' are improvement tools and techniques, continuous improvement system, human resource development, conducive work environment, availability of resources, and people and customer management.

The following scale in table 3 was chosen for effective determination of the strengths, and impediments and obstacles of successful implementation of LPS in the UK SMEs.

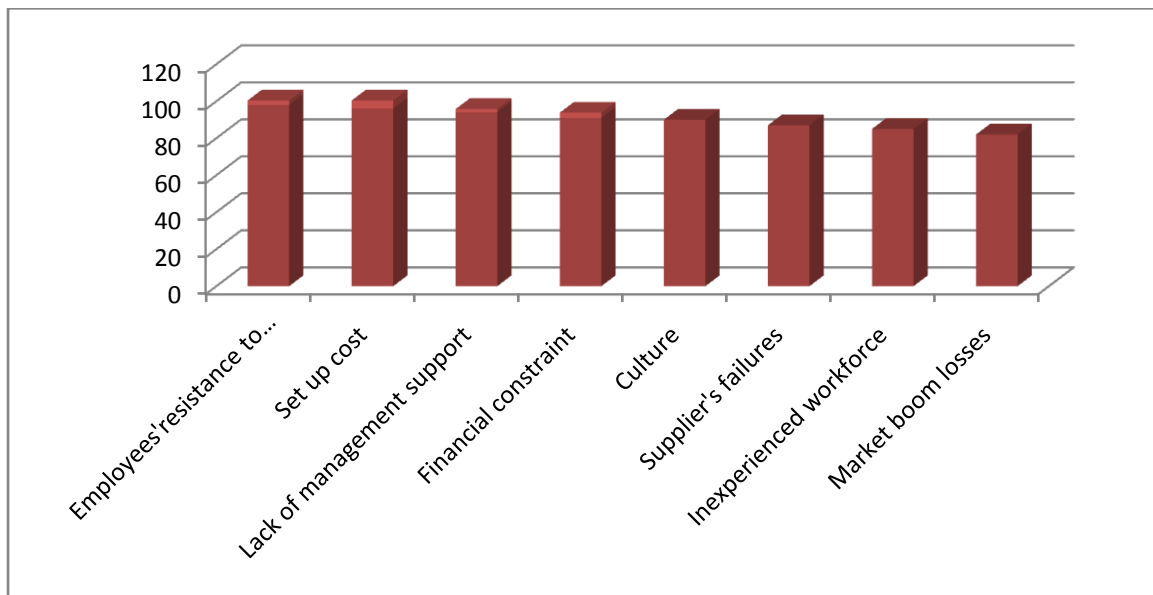
Table 3: Scale for the analyses of strengths and impediments of implementing LPS

OPTION	POINT
Don't know	1
No effect	2
Low effect	3
High effect	4
Very high effect	5

The analysis of the results showed that Waste reduction is the most important strength/benefit of the implementation of LPS, as it has 109 points from the total of 120; it was preceded by Lead time reduction, Increase in profitability, Throughput increase, Customer satisfaction, Space reduction, Inventory and Work in progress reduction, Increase in quality, Overheads reduction, Production cost reduction, Need for inspection reduction, Beating the competition, Increase in market share, and Improved sales, with 107, 106, 102, 101, 101, 100, 100, 95, 92, 90, 87, 79, and 75 points respectively.

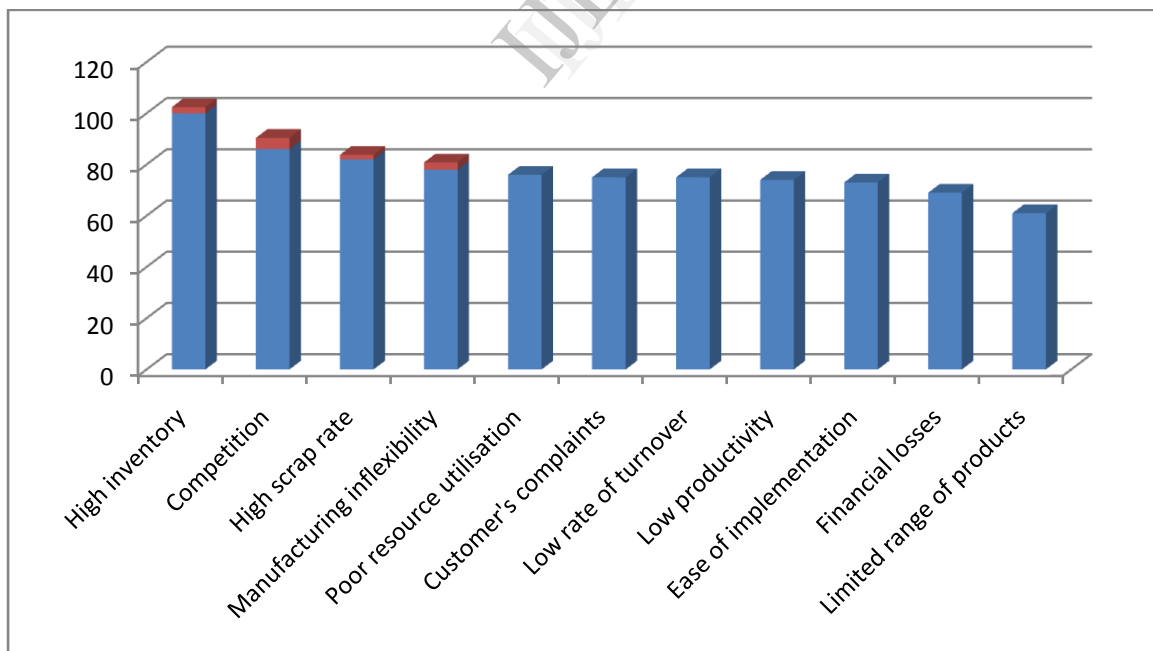
The analysis of the impediments and obstacles of LPS implementation in UK SMEs revealed that the employees' resistance to change topped the list, trailed by set up cost, lack of management support as shown below in figure 10.

Figure 10: Impediments and obstacles of LPS implementation



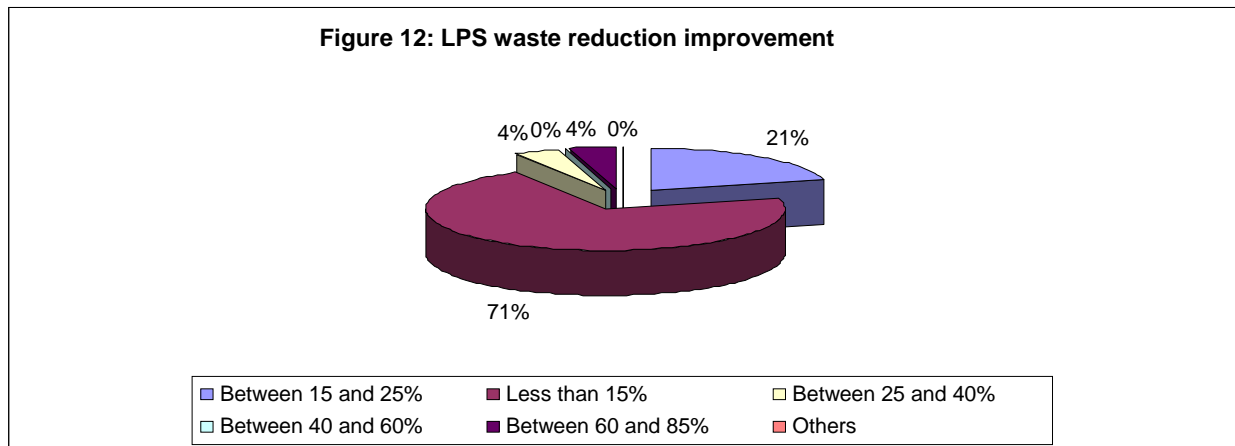
In figure 11, the factors that influenced the decision of UK SMEs to adopt LPS were analysed and the result showed that high inventory has the highest influence on their decision to implement LPS.

Figure 11: Factors that influenced the decision to adopt LPS

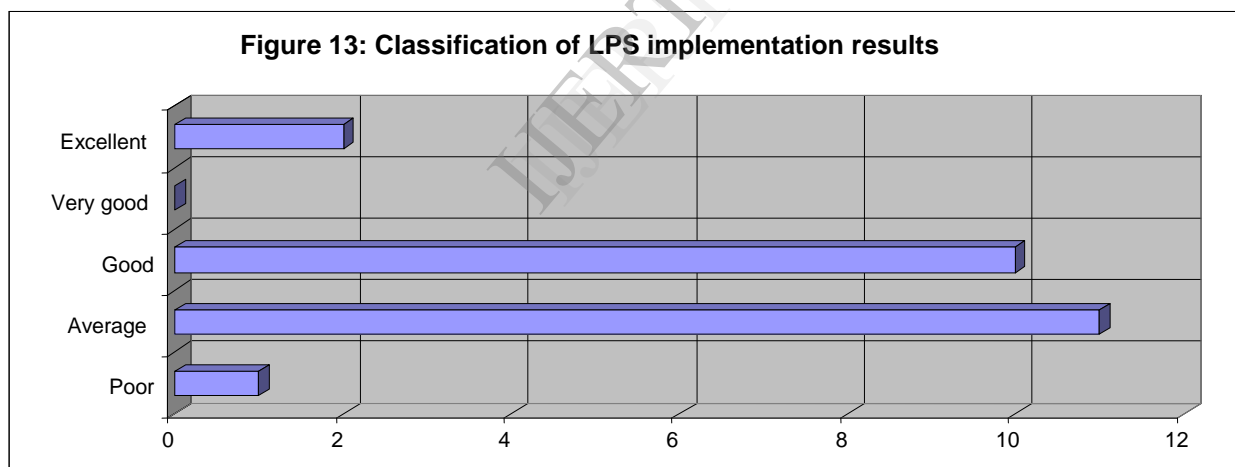


The survey revealed that majority of the UK SMEs that are implementing LPS have not really achieved much improvement in waste reduction with the implementation of LPS. As

shown in figure 12, 71% of the companies achieved less than 15% improvement when compared with their pre-LPS era.



Also only 8% of the respondents as can be seen in figure 13 classified the result of the implementation of LPS in their organisations as excellent, while 11 companies or 46 percent classified theirs as just average.



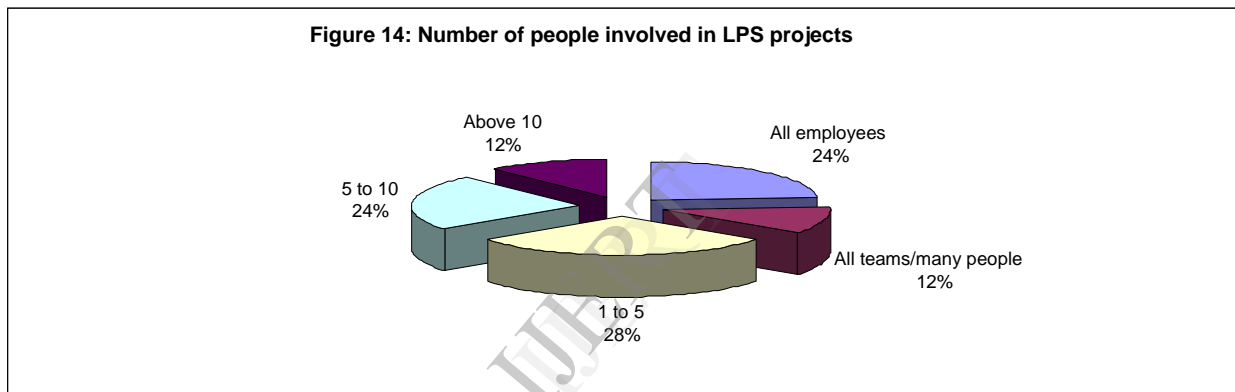
On how they perceive the future of LPS in their different companies, 20 of the 24 respondents observed that the manufacturing method will continue to grow in importance, while the remaining four were pessimistic as they believed that LPS will end up becoming less important in their establishments.

Another issue of importance was the determination of how LPS was implemented in the UK SMEs; the survey result showed that 14 companies or 58% of the respondents were partly implementing LPS, unlike the remaining 10 companies that were implementing it wholly.

On the criteria for choosing LPS in their companies, Improved efficiency topped the list, followed by Customer driven, Improve productivity, Parent company's prompting, Inventory/Work-in-progress reduction, Linked to ISO 14001, Improve supplier's performance, Waste reduction, Improve factory's cleanliness.

As regards to team formation for LPS implementation, 12 companies answered in the affirmative, 11 others do not have an LPS team, while one company did not provide an answer to the question.

Shown in figure 14 is the number of people that were involved in LPS projects in the various organisations.



The number of training days on LPS given by the companies to their employees varied considerably, as it ranged from half to 30 days. Many of the respondents pointed out that what they mentioned were the initial trainings, as they continued with on-the-job trainings. Surprisingly two companies pointed out that they did not spend any day to train their employees; however, one of them argued that all its employees are engineering graduates and therefore do not require any form of training on LPS. Meanwhile, not all the companies provided the answers to the question as it was open-ended.

Also an open-ended question, the respondents had different answers on the curriculum for their LPS training; two respondents gave theirs as Five S, while the rest listed the following: Single Minute Exchange Dies (SMED), Process Continuous Improvement, LPS Tools and Techniques, Performance Measures, Lean Accounting, Variety of Courses, Overview, and Value Stream Mapping (VSM).

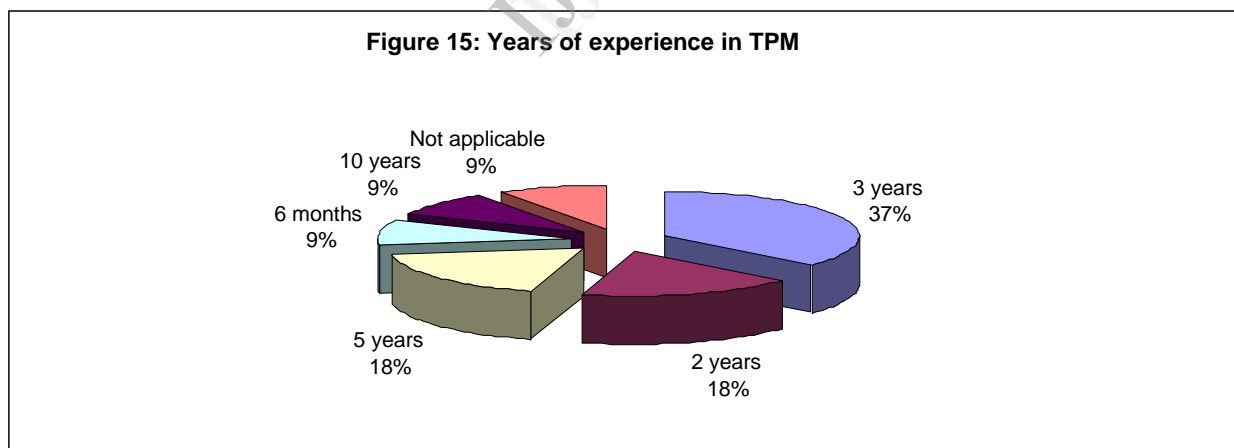
The answers provided by the respondents on the problems they encountered at the LPS trainings as well as how they were solved are shown on table 4.

Table 4: Encountered problems and solutions during Lean training

ENCOUNTERED PROBLEM	SOLUTION
Culture	Change staff's way of thinking
The staff reluctance to accept change	Overtime benefits sold the change
Employees lack of interest	Motivation
Staff's insistence that they can't make it	Proper orientation
Down time	Just-in-time

The survey also revealed that 9 of the companies are partially implementing Total Productive Maintenance (TPM), with 5 of them fully implementing it, while the remaining 10 companies are not implementing the manufacturing technique.

The number of years of experience in TPM implementation by the participating UK SMEs is shown in figure 15.



The last question was aimed at identifying different things that would be done differently by the UK SMEs if they are about to implement LPS for the first time in their companies. The various answers provided by the respondents are listed below:

- Involve the workforce more to gain their support more readily;
- Nothing – it is a learning curve;
- Higher investment;
- Training up to the director's level;
- More team work;
- Develop team focus earlier in the scheme;
- Involve more people;
- Add more resources at the onset;
- Involve everyone from the start; and
- Close the factory and start something else.

Conclusion

The success of the survey could mainly be attributed to its ability to achieve the research objectives which were the key findings. They revealed the current status of UK SMEs, the major tools and techniques of LPS they are applying in their companies for better results, the critical success factors of implementing LPS, as well as the obstacles and impediments that militate against the successful implementation of the manufacturing method in their different firms.

On LPS tools and techniques, the survey showed that 100% or all the participating companies that were implementing LPS in their organisations are all aware of Just-in-time, thereby showing that it is the most popular tool and technique of Lean Production System, unlike single piece flow which was known by only 10 of the companies.

The questionnaire survey identified Five S practice as the most useful and most frequently used tool and technique of LPS, as most of the companies in turn explained that it is highly beneficial to them due to its ability to ensure that shop floors are kept clean and tidy all the time, thereby creating a conducive manufacturing centre that is devoid of accidents. This was also corroborated by all the respondents in the semi-structured interviews, where they also emphasised on the importance of Five S practice in their different establishments.

The survey findings revealed that none of the participating companies have been implementing LPS for more than 10 years, as a greater percentage of them fell within the range of between 1 and 3 years. Also the result showed that the UK SMEs were assessing their performance measures with different factors especially with inventory and waste reduction, lead time and cycle time reduction, and throughput. In terms of financial benefits majority of the respondents stated that they do not know the value of the financial benefits they have achieved with the implementation of LPS, however, greater percentage of those that mentioned their financial benefits pointed out that it is less than 50 thousand pounds per annum.

The findings were also similar as regards to the improvement the companies achieved in waste reduction and how they will classify their overall LPS implementation, as the rating was not very impressive though they were far better than their pre-LPS era.

The above findings showed that the current status of LPS in UK SMEs is not very impressive, as although there are many improvements which are far better than what could be achieved with any other system of manufacturing; the companies have not really achieved much in terms of waste reduction and financial benefits, which could be attributed to the recent history of LPS implementation by the UK SMEs, as well the limited knowledge the companies have on the LPS tools and techniques, especially as it regards to their inability to implement all of them harmoniously, as LPS implementation should be all-encompassing and not just about the selective and haphazard implementation of some of its tools and techniques.

ABSTRACT

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