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A Survey of Optimum Manufacturing Strategy as a Tool for Enhanced Industrial Revenue

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ABSTRACT: This paper presents a detailed understanding of Optimum Manufacturing Strategy (OMS) also called Lean Production System (LPS)), a manufacturing approach that is aimed at applying fewer resources to manufacture high quality products that meet the customer's requirements at less time, thereby increasing throughput and profitability. It also reviewed the numerous advantages of OMS through classical reports and survey studies. All the activities and the benefits, the common tools and techniques, the critical success factors, and the impediments and obstacles of OMS implementation were also discussed in detail. To achieve the research objectives, past literatures on the topic were reviewed. Apart from being applied to achieve continuous improvement through the identification and elimination of all wastes that are inherent in production processes, the study showed that the other advantages of the implementation include the reduction of the lead time, cycle time, inventory and work-in-progress, production cost, space, overheads, and the need for inspection of products. Other benefits are customer satisfaction, beating the competitors, as well as the increase in the profitability, throughput, and flexibility, quality of products, sales, and market share.

Key words: Lean production system; throughput; Just-in-time; kaizen; work-in-progress; lead time; kanban; single minute exchange of dies; five-S; overheads; cycle time; value stream mapping.

INTRODUCTION

New technologies, competition from the multinational companies, and globalization which lead to the increase in the importation of high quality products from other countries of the world has over the years adversely affected businesses in many nations, as their ability to market their products and increase their profitability has being drastically reduced. To this end, the manufacturing firms had no other option than to either increase the quality of their products to meet the international standard or be forced out of business.

Therefore in order to increase their market share and profitability, they have been seeking for better and more cost effective ways of production. This search has made them to question the successes being achieved by the Japanese manufacturing companies and to identify the manufacturing principles that have enabled them to attain an enviable height in the manufacturing sector.

They realised that the Japanese manufacturers unlike their western counterparts that rely heavily on mass production, has within a short period developed and has been implementing a better manufacturing approach which was pioneered by Toyota Motor Manufacturing Company. The manufacturing method which later came to be known as Optimum Manufacturing Strategy (OMS) or Lean Production System (LPS) is a manufacturing philosophy that is fashioned to respond quickly to the customer's requirements. It is aimed at the elimination of all wastes and non-value adding activities in manufacturing processes.

Unlike mass production that is geared towards the manufacturing of large quantity of products, OMS is aimed at increasing efficiency and reducing production cost by manufacturing the exact number of high quality products when they are needed by the customer, with emphasis on the keeping of very low inventory. According to (Ohno, T., 1998), the best approach of improving productivity is for manufacturers to produce only the exact amount of products they require with the minimum number of employees, he pointed out that efficiency is sensible only when it achieves cost reduction.

Apart from identifying and eliminating wastes, OMS enables organizations to be more profitable through the application of fewer resources to manufacture more quality products at a faster rate, thereby leading to competitive advantage and customer satisfaction.

As shown below in figure 1, the major focus of OMS according to, (Shinkle, G., 2004) are to: achieve customer satisfaction, enhance value through the elimination of waste, reduce cycle time through response to speed, improve flow, and flexibility to ensure customer satisfaction.

Schonberger (Schonberger, *et al*, 2000) stated that Optimum Manufacturing Strategy is an approach to manufacturing which aims at achieving greater results with fewer resources. They observed that it "focuses on total quality management, just-in-time production, waste elimination, continuous improvement, multifunctional teams, product design, and supplier partnerships." They maintained that it "does not only focus on core

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production activities, but also aimed at product development, component procurement, and product distribution."

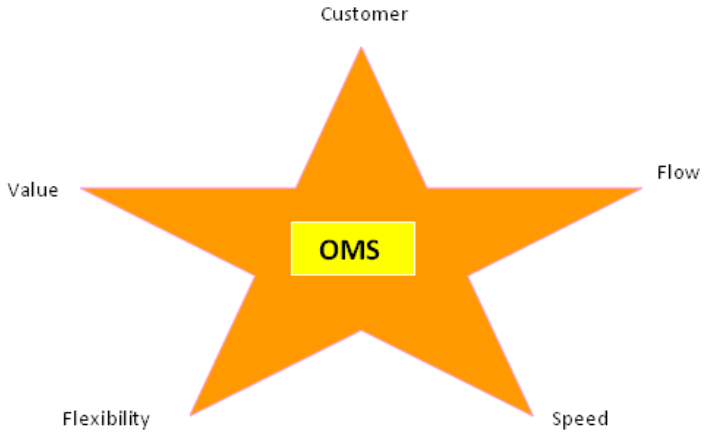

Fig. 1: The OMS Focus Star (Shinkle, G., 2004).

Optimum Manufacturing Strategy (OMS) is "an integrated manufacturing approach 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.

The whole concept of OMS 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 (2000) explained that Optimum Manufacturing Strategy 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, OMS is also aimed at the production of highly reliable products in a very conducive workplace. Reisman and Burns (2006) OMS 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 OMS also "stressed lasting, collaborative relationships with suppliers and business partners."

Womack *et al*., (1990) explained that Optimum Manufacturing Strategy "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, OMS is therefore targeted at detection, isolation and elimination of all possible wastes in manufacturing through continuous improvement.

As could be observed from figure 2, 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, OMS is geared towards eliminating all the waste in manufacturing as well as improving the value stream

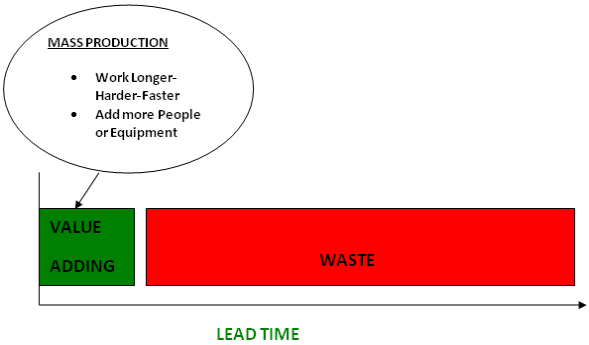

Fig. 2: Waste elimination-OMS versus Traditional approach.

Apart from waste (muda) detection and the subsequent elimination, the main aims of OMS are reduction of lead time and manufacturing costs, increase in flexibility, quality, and production rate, as well as ensuring that the product is delivered to the customer when it is required. The main aim of Optimum Manufacturing Strategy is to achieve maximum profit by lowering the overall manufacturing costs of products through the elimination of all the wastes that are inherent in manufacturing (Ohno, T., 1998).

While highlighting some of the benefits of optimum production in a recent survey, (Carbone, J., 2006) pointed out that with OMS, "a manufacturer carefully reviews his processes and identifies areas of waste." He indicated that it ensures the reduction in overheads and the level of inventory thereby leading to an increase in the quality of products, as production is made more effective. The application of OMS enables organisations to stop the delivery of large volumes of inventory from their suppliers but rather resort to obtaining them in frequent smaller batches.

Commenting on the benefits of OMS, (Drew, J., 2004) concluded that it is the best approach of manufacturing, as it does not only lead to quality improvement and reduced production costs, but also ensures the stability of operations while matching 'supply with demand'.

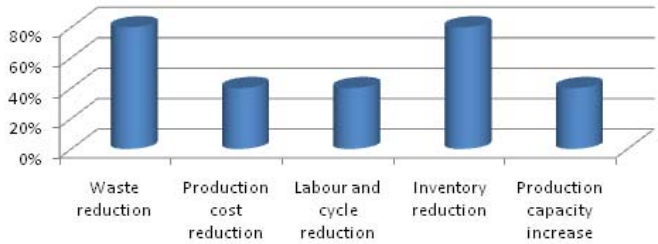

Fig. 3: Typical benefits of OMS.

Apart from the reduction of waste and increase in the quality and reliability of manufactured products, there are numerous other benefits of OMS as it affects all the facets of any company that adopts it. Allen *et al.*, (2001) explained that Optimum Manufacturing Strategy benefits continue for a very long time after the completion of its implementation. They argued that through the provision of "long time growth and strength, Optimum manufacturing is much more than today's savings – it is a long-term way of doing business that provides continual payback."

Kerr (2006) listed the following as the five guidelines of realising the numerous benefits of the processes of OMS.

- Ensure that value is well defined from the customer end's point-of-view, well divided by product grouping;
- By using Value Stream Mapping ascertain for every product all the processes in the value stream, removing all the non-value adding processes. The value stream entails both the value adding and non-value adding steps and processes that a product undergoes from "concept to launch and from order to delivery";
- Move the product steadily towards the customer by ensuring that the value adding processes takes place in a harmonised sequence;
- Introduce "flow" and ensure that the customer from the subsequent upstream activity is responsible for value pull; and
- Start the process all over by value definition, value stream steps identification, removal of non-value adding processes and flow and pull introduction. Be consistent to create a perfect value that is devoid of waste.

Some of these benefits as shown in Figure 3 above include: outstanding decrease in work-in-progress, overall costs, reduction in lead time, overhead cost, and shop floor space, it also increases the quality of products, throughput, rate of productivity, flexibility, inventory turnover, customer relationship, and Profitability. Also it is a 'win win' situation for any company that adopts and fully implements the manufacturing system as it offers immense benefit to the manufacturer, the employees and the customer.

2 Tools and Techniques of Oms:

The application of OMS tools and techniques assists in starting improvement processes, increasing the overall awareness of quality and also enhances the change of attitude of employees. Dale (2003) explained that tools and techniques of OMS are used to "aid quality planning, listen to the 'voices' of the customer, capture data, control processes, make improvements, solve problems and improve people."

However, the various tools and techniques will not achieve the desired results if they are not properly utilized; this is because OMS is not just the application of a bunch of tools but rather a completely different approach of manufacturing.

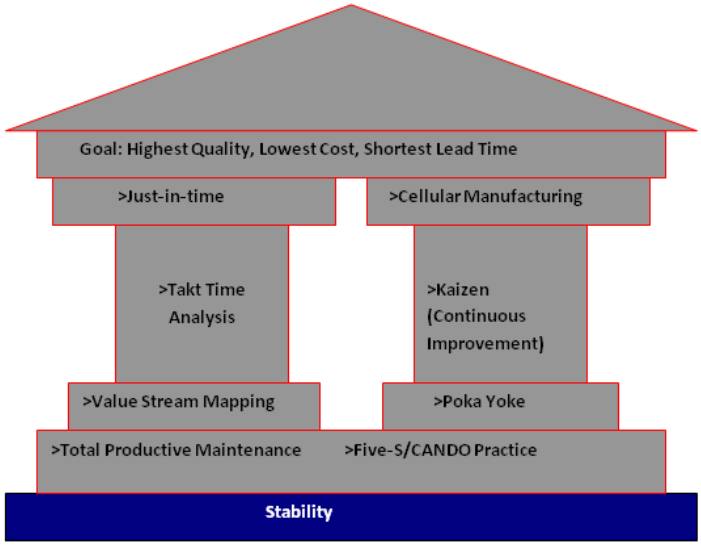

Fig. 4: OMS tools and techniques' 'house'.

As shown in figure 4 above, some of the tools and techniques of OMS include: Cellular Manufacturing, Just-In-Time, Total Productive Maintenance, Value Stream Mapping, Poka Yoke (Error Proofing), Five-S practice, Single Minute Exchange of Dies, Takt Time Analysis, Kaizen (Continuous Improvement), and Visual Management. The applications, strengths, and limitations of the various OMS tools and techniques are listed in table 1.

Table 1: The applications, strengths and limitations of OMS tools and techniques.

TOOLS/TEC-HNIQUES	APPLICATIONS	STRENGTHS	LIMITATIONS/ PROBLEMS
Cellular Manufacturing	Shop floor.	Uninterrupted movement of materials, overhead cost reduction, enhances flexible manufacturing.	High set up cost.
Just-In-Time	Supply chain, manufacturing.	Improves productivity and profitability, reduces inventory, costs and lead time.	Leads to losses sometimes due to stoppages in production as a result of suppliers failures.
Total Productive Maintenance	Machines and equipment.	Machines and equipment safety and maintenance, increase in productivity, defect reduction.	Delay in yielding of results.
Value Stream Mapping	Supply chain, manufacturing.	Provides information and material flow, reduces cost and lead time.	Does not incorporate management of human resources and the development of products.
Poka Yoke	Manufacturing processes	Eliminates errors and mistakes, reduces defects, and improves quality of products.	Requires set up time.
Five-S Practice	Shop floor	Ensures neat shop floor, improves productivity, and reduces waste.	Requires constant work and updating.
Single Minute Exchange of Dies	Machines	Set up time reduction, increase in productivity and flexibility, reduction in inventory and wastes.	Requires High set up cost.
Takt Time Analysis	Manufacturing processes	Synchronizes demand and manufacturing, reduces wastes.	Difficult to apply in the manufacturing of diverse products.
Kaizen	All production processes	Reduce wastes and inventory, improves productivity, quality of products and flexibility.	Results to flow disruptions.
Visual Management	Shop floor	Enhances productivity, efficiency and quality.	Requires constant updating.

In a recent study (Michel, R., 2005) observed that the success of OMS is highly dependent on proper incorporation of skills and strategy with a principle that promotes Optimum production at both inside and outside the shop floor. He identified "flexibility, responsive materials handling and a broad supply chain view" as the major components of Optimum success. For an organisation to be successful in its implementation of OMS, it needs to involve all the members of its workforce, as their loyalty and total commitment are very crucial for proper implementation of the manufacturing method.

Schonberger (2000) suggested that in order to make remarkable progress in adopting OMS, a company requires an "environment where workers are empowered, teamwork is encouraged, creativity is fostered, and the complete involvement of all employees is nurtured." He maintained that this also involves structurally reorganising the firm so as to enhance the "development of multiple career paths within the organization." Some of the critical success factors for successful implementation of OMS in firms include: Leadership, organisational culture, financial capability, expertise and skills, and management.

As shown in figure 5 below, the leadership of a company plays a very prominent role in determining the outcome of the application of the systems of Optimum production due to their strategic roles in decision making which will either make or mar the whole exercise. The importance of having a focused leader who is goal oriented in a company that is implementing the manufacturing approach cannot be over emphasised as he actively participates throughout the process thereby ensuring its full implementation.

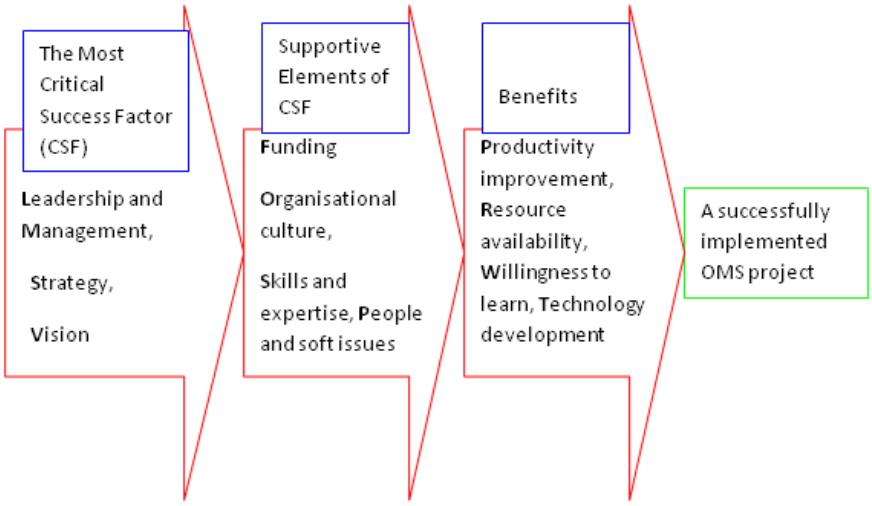

Fig. 5: Elements of critical success factors for a successful OMS implementation (Achanga, P., *et al*, 2006).

Determination and consistency is another very important factor for the successful implementation of OMS in an organisation, as the whole concept is aimed at continuous improvement of all the manufacturing processes. Organisations most times expect an immediate result the moment they begin implementing the method of manufacturing, which is not always the case as it requires persistence over a long period of time.

Suppliers also play a very prominent role in the success of OMS, this is because the manufacturing method requires the keeping of very low level of inventory and any disruption in it will definitely stop manufacturing processes, thereby leading to losses. To ensure the steady flow of materials, OMS focuses on the maintenance of healthy relationship with the suppliers that will always guarantee the provision of raw materials when they are required.

The inability of some companies to successfully implement the principles of OMS in their organisations can be blamed on some barriers and impediments which they often encounter. Boyer and Sovilla (2003) noted that the major obstacles are wrong estimation of the impacts of principles and management, the wrong impression of progress, inconsistent measures, unprincipled, and the use of OMS as just manufacturing tools instead of a way of engaging in business.

Some of the companies also experience supplier-related problems, as proper implementation of OMS entails the maintenance of minimum amount of inventory, the organisations require effective suppliers that will be able to deliver exact amount of components and raw materials at exactly when they are needed. This therefore constitutes a barrier to OMS implementation as Optimum compliant suppliers are often difficult to come by.

The setting up of OMS in a company most times is quite difficult as it involves an enormous amount of money; this is because all the manufacturing systems need to be completely overhauled. The cost of implementation arises as a result of setting up of cell manufacturing plant, trainings, and other logistics which are the pre-requisite for an efficient introduction of OMS. This explains why some firms are still applying the traditional system of manufacturing.

Nicholas (1998) listed the following as some of the barriers and impediments of implementing OMS:

- Dissipating energy and efforts in solving the inconsequential problems facing an organisation and ignoring the few that are very crucial;
- Focus on "internal processes" to the detriment of customer oriented results;

- Inadequate reforms and emphasis on short term benefits;
- Unfocused and irrelevant trainings; and
- Lack of coordinated team work.

Furthermore, most leadership and management of these firms also constitute barriers to successful introduction and implementation of OMS to their establishments, as they fear that it may end up aggravating the problems already inherent in their system rather than getting them solved, this is as a result of their belief that the successes recorded by the manufacturing approach in Japan could be attributed to the Japanese culture.

Also, non commitment, lack of empowered workforce, and wrongful use of the tools and techniques of OMS by some manufacturing companies that has already adopted the manufacturing method in their firms are other impediments in the successful implementation of OMS.

The high rate at which many manufacturing companies has been adopting the principles of OMS over the years could be attributed to the numerous advantages it has over the traditional or mass production system of manufacturing. However, the system also has some limitations as shown in table 2, although the strengths far outweigh it.

Table 2: Strengths and limitations of OMS.

STRENGTHS OF OMS	LIMITATIONS OF OMS
Waste Elimination	High set up cost
Increases productivity and quality of products	Supply chain Risk
Enhances profitability	Market boom losses
Production of high quality products	Requires highly skilled workforce
Inventory and WIP reduction	Production stoppages due to suppliers' failures
Reduces lead time/Time to market	
Enhances production flexibility	
Reduces Production cost	
Creates conducive working environment	
Increases throughput	
Enhances customer service	
Reduces cycle time	

3. A Survey and Analysis of the Extent of Industrial Application of Oms:

A total of 300 questionnaires were sent out by E-mail to some manufacturing companies 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. The questionnaires were targeted at the manufacturers in the automobile, aerospace, electronics and the plastics industries, as many of them have been implementing and reaping the many benefits of Optimum Manufacturing Strategy (OMS) for quite some time.

As shown in figure 6 below, 8 of the 50 responses were blank, 1 of them stated that the company has already been closed down, 2 respondents declined to participate in the survey, 15 could not complete the questionnaire as they explained that they were not implementing OMS in their organisations, while 24 or 48% of the companies are actually practising the manufacturing method.

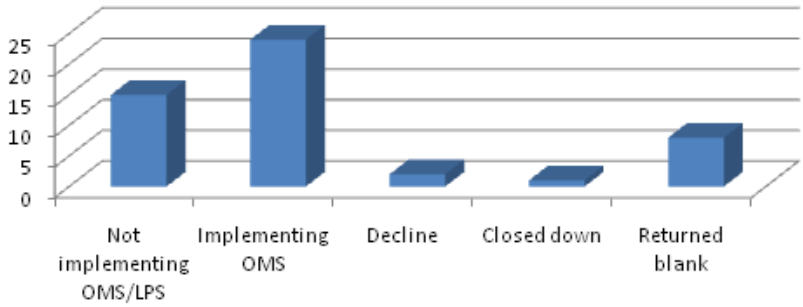

Fig. 6: Received responses from the Manufacturing companies.

The survey revealed the implementation period of OMS/LPS. Interestingly as shown in figure 7, all the participating companies have a recent history of LPS implementation, as the introduction of the manufacturing method in their various companies has not exceeded 10 years.

It was realised that the participating companies were not using just one measure to appraise the performance of OMS in their establishments, but were rather using two or more. As shown in figure 8 below, 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 OMS performance.

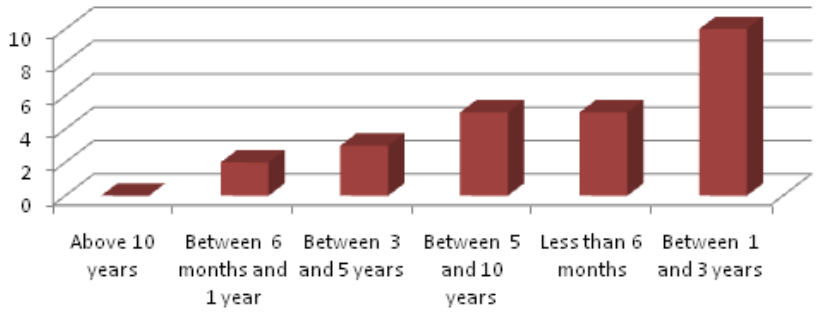

Fig. 7: Period of OMS Implementation.

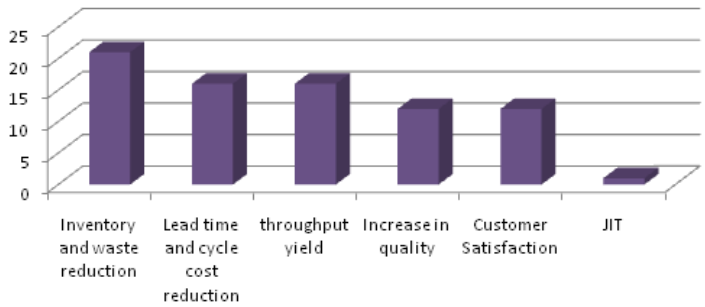

Fig. 8: OMS Performance Measures.

From figure 9, it can be observed that 54% of the respondents were reluctant to mention the financial benefits their organisation has gained from implementing OMS, as they selected a 'Don't know' option. However, 29% of the respondents pointed out that their financial benefits for implementing OMS 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.

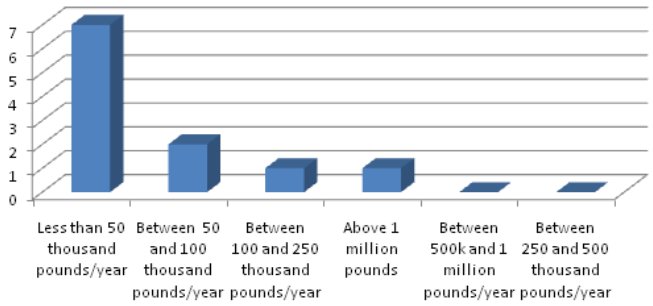

Fig. 9: Financial Benefits of OMS Implementation.

Another interesting factor that was analysed was the knowledge of OMS/LPS tools and techniques. As shown in figure 10 below, all the manufacturing companies in the survey are not aware of all the tools and techniques of OMS, only 13 companies know about value stream mapping while 6 of them are ignorant of the important tool. However, due to its popularity JIT was the only OMS tool and technique that is known by all the respondents.

As an open-ended question, only 10 respondents provided their answers to the most commonly used tools and techniques of OMS. As shown below in figure 11, the result revealed that Five S is the most commonly used tool by the companies that are implementing OMS.

In the survey, the management/leadership involvement and participation was identified by the companies as the most crucial success factor of implementing OMS, while others are skills and expertise, customers, organisation's infrastructure, finance, Education and training, improvement tools and techniques, continuous improvement system, human resource development, conducive work environment, availability of resources, people and customer management, as well as cultural change.

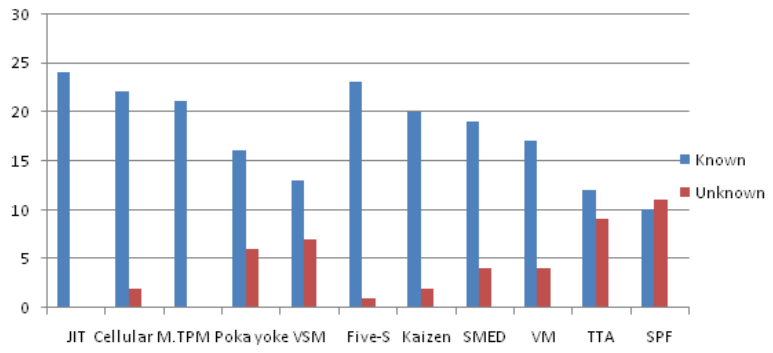

Fig. 10: Knowledge of OMS tools and techniques.

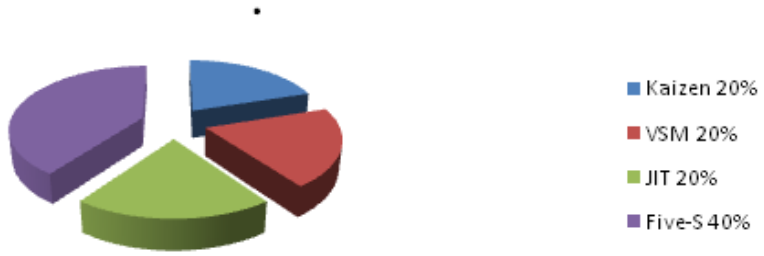

Fig. 11: The most commonly used tools and techniques of OMS.

The manufacturing companies also identified waste reduction as the most important strength/benefit of the implementation of OMS, it was followed by lead time reduction, beating the competition, increase in profitability, overheads reduction, production cost reduction, space reduction, cycle time reduction, inventory and work-in-progress reduction, and reduced need for inspection. Others are increase in: throughput, quality, customer satisfaction, market share, and sales.

Also only 8% of the respondents as can be seen in figure 12 classified the result of the implementation of OMS in their organisations as excellent, while 11 companies or 46 percent classified theirs as just average.

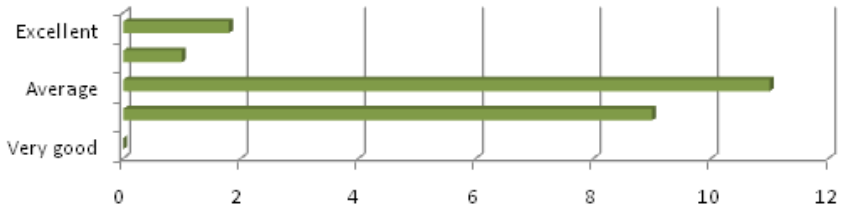

Fig. 12: Classification of OMS implementation result.

The last question on the questionnaire was aimed at identifying different things that would be done differently if they are about to implement OMS 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.

4. Conclusion:

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. The results also showed that the current status of OMS is still very far from satisfactory as the companies has not really benefited so much from its implementation. These could be attributed among other things to the limited knowledge the manufacturing companies have on OMS tools and techniques, especially as it regards to their inability to implement all of them harmoniously, as OMS implementation should be all-encompassing and not just about the selective and haphazard implementation of some of its tools and techniques.

The research also revealed that 100% or all the participating companies that were implementing OMS in their organisations are all aware of Just-in-Time, thereby showing that it is the most popular tool and technique of Optimum Manufacturing Strategy, unlike single piece flow which was known by only 10 of the companies.

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 OMS, however, greater percentage of those that mentioned their financial benefits pointed out that it is less than 50 thousand pounds per annum.

In order to achieve the desired results of the implementation of OMS at a faster rate, manufacturing companies should always strive to implement most if not all of the tools and techniques; this is because Optimum manufacturing Strategy is highly dependent on synchronized relationship between the different tools and techniques. Although the application of some of the tools and techniques will result to a considerable amount of success, a company can only be referred to as a good optimum manufacturing company if it embarks on daily continuous improvement.

The findings of the survey validated the reports on past literatures on Optimum Manufacturing Strategy as it proved that it is a 'win win' situation for any company that adopts and fully implements the method of manufacturing, as it offers immense advantage to the manufacturer, the workers and the customer.

Although a lot of work and efforts were channelled into the successful completion of this survey, it is far from been completed as there are still rooms for innovations and improvement. Future research on OMS can therefore concentrate on its application on big companies where the results can be compared with the findings of this work.

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