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Lean Manufacturing for SMEs: enabling rapid response to demand changes

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1. Introduction

Small and medium sized enterprises make significant contributions to most national economies. In the UK for instance, they account for up to 40% of the gross domestic product GDP and 85% of newly created jobs [1]. However, the current economic turnaround that has been fostered by the recent technological advancement in terms of e-commerce, coupled with the advent of globalisation, has seen the manufacturing sector in general; but more severely affected are the small and medium sized manufacturers (SMEs). This paper aims to demonstrate through a case study approach, how LM can enable organisations to respond rapidly sudden changes in customer demand.

2. Literature review

Past research studies reveal that LM aids the success of global enterprises by enabling rapid response to changes in demand [3-5]. In order to continue to assert themselves in the market, SMEs need to operate minimal cost processes, which can only be possible if they clearly comprehend real cost issues [2]. The use of lean manufacturing (LM) as a means of enabling SMEs to

react to sudden demand changes is proposed. SMEs can find themselves in precarious situations since they are often caught up in fierce competitive market environments where they suffer from several disadvantages such as, their size and capital bases. LM provides organisations with the mechanisms to improve their production process by a reduction of waste in human effort and in inventory [6-8]. Organisations are therefore geared-up to react efficiently and responsively to the market environment as and when the situation warrants [9-10]. However, others have argued that volatile demand scenarios may constrain the application of lean principles, hence the discarding of techniques such as just-in-time (JIT) [11-15]. Depending on how the situation is viewed, we infer that LM is a very useful paradigm that provides organisations with the capabilities to manage unscheduled customer demands.

3. Methodology

This research study was conducted through a number of research mediums. First and foremost, a survey of published literature was carried out. The Literature survey enabled the identification of current LM practices as used by industry. The review focused specifically on the subject of lean manufacturing and its impacts on SMEs. Literature survey was followed by a one year company visits that involved a number of SMEs. This was to investigate the manufacturing and the lean practises in those companies. Eventually, the study centred on five SMEs who have successfully implemented LM within the businesses. The research wanted to investigate how lean was implemented in the SMEs, the training carried out and the cost of the project.

The study also investigated how LM transformed the SMEs production flow, output, lead-time as well as delivery-time. Data on the above information were collected through the following techniques; direct observations semi-structured questionnaires and the interviewing of key experts. Results obtained were then verified through expert opinions, case studies and workshops. Data were also traced on the companies' performances before lean was introduced. This was later compared with the results after LM.

4. Demand Changes

The pattern of demand for a commodity may change with the variations in price and the quantity supplied in the market [16]. To date, many providers have cropped up in the market place, meaning that customers are able to make endless choices. Sloman [17] maintained that supply of products may also be determined by the production capacity since there is a relationship between customer delivery lead-time and the level of finished goods in a make-to-order system [11]. It can be argued that, LM is supportive of good manufacturing practices and efficient flow of materials through the production process [11]. This is evidenced in the case of larger sized enterprises who realised that they could no longer remain in contention by continuing to operate a traditional mass production, large-batch-sized, make-to-order model; instead they are shifting to higher variety, small lot sizing i.e. only producing what the customer wants, when the customer exactly wants it-JIT [9]. However, previous studies have found that most SMEs have not yet realised the full implications of this paradigm shift [19].

Although it can be inferred that a large majority of SMEs have still not appreciated the concept of going lean; some UK SMEs have benefited from its implementation. One such SME is Ruston Electronic Limited, which is an electronics service company, offering design through to manufacture of instrumentation as defined by the client [20]. This company experienced quality defects as it strove to meet a surge in customer demand. Decline in quality of output and a fall in on-time delivery to 73.6 percent meant it could not satisfy its customer needs more effectively [20]. The implementation of the lean principles in Rustons was its major breakthrough, as the company's product flow system achieved a 50 percent increase in throughput with a boost in on-time delivery 100 percent [20]. In the words of Pullin [21], "the essence of lean is to bring operations into line so they are pulled by customer demand rather than pushed from behind by waste-forming habit [21].

5. Manufacturing issues

SMEs are characterised by a number of challenges that impinge on their operational structures. Most SMEs are caught up in situations where they are not able to adapt to new ideas. Figure (1) illustrates the manufacturing issues that are regarded as major inhibitors to SMEs performance.

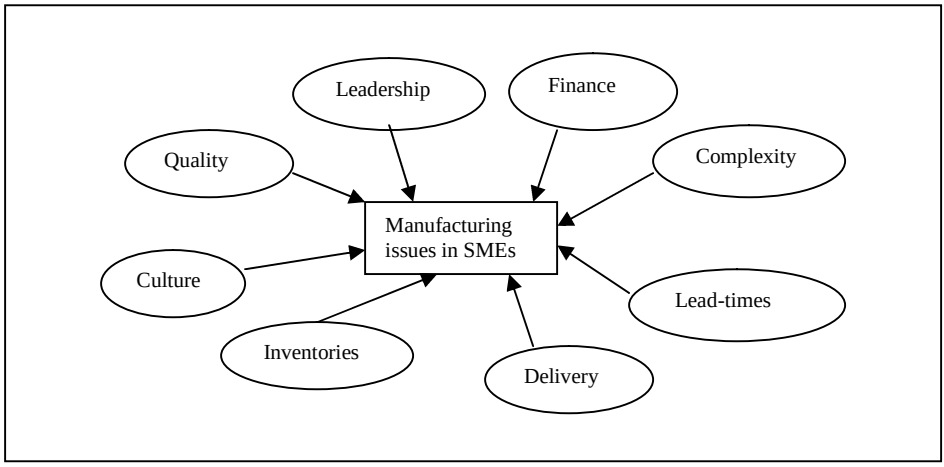

Figure 1. Manufacturing issues in SMEs

The fundamental to a successful organisation is its ability to be led effectively [22]. Good leadership is a factor that enhances improved performance in any sector [23]. Moreover, the 21st Century business environment has saturated the market place so much so that only those businesses that can cope with change are able to compete and survive. Unfortunately, family members tend to take up management positions in SMEs even when they do not have the know-how [24]. SMEs are thus constrained by a lack of strategic improvement initiatives that are now the norm for larger organisations [25]. Moreover, SMEs are characterised by a meagre financial capital base that does not allow for research and development (R&D) programmes.

The effects of the financial incapacitation ripple through the SMEs corporate framework, rendering them ineffective. As illustrated in Figure 1, SMEs have unclear objectives that are

characterised by complex process flows. The complexity leads to duplications and longer lead-times. The eventual outcome is late delivery to the market which might have resulted from the unclear definition of design parameters. It can be argued that LM enables an organisation to adopt a “helicopter view philosophy” in assessing its overall performance. The use of lean techniques such as value stream mapping (VSM) assists an organisation in identifying its problem and the probable causes. Solution can then be sought while the pieces are put together.

6. Hypothesis

It can be hypothesised that the implementation of lean principles can have significant impacts on the overall business function, as shown in Figure (2). A well implemented lean idea can provide an organisation with a high production output. The reason being that lean manufacturing dictates a sound corporate culture within organisations.

The creation of a supportive organisational culture would therefore be an essential platform for a conducive working environment [19]. In turn, it can be hypothesised, the entire workforce can become motivated due to flexible working polices that provide job satisfaction. Staffs are thus inclined into putting excess efforts to their quest to achieve maximum productivity.

As staffs become satisfied with what they perform, the idea of them achieving defects free units of production becomes an integral part of the system. More often than not, there brews up the notion of internal competitiveness where employees pity themselves against each other. Workers will therefore strive to be innovative and creative in their daily jobs, hence qualitative production.

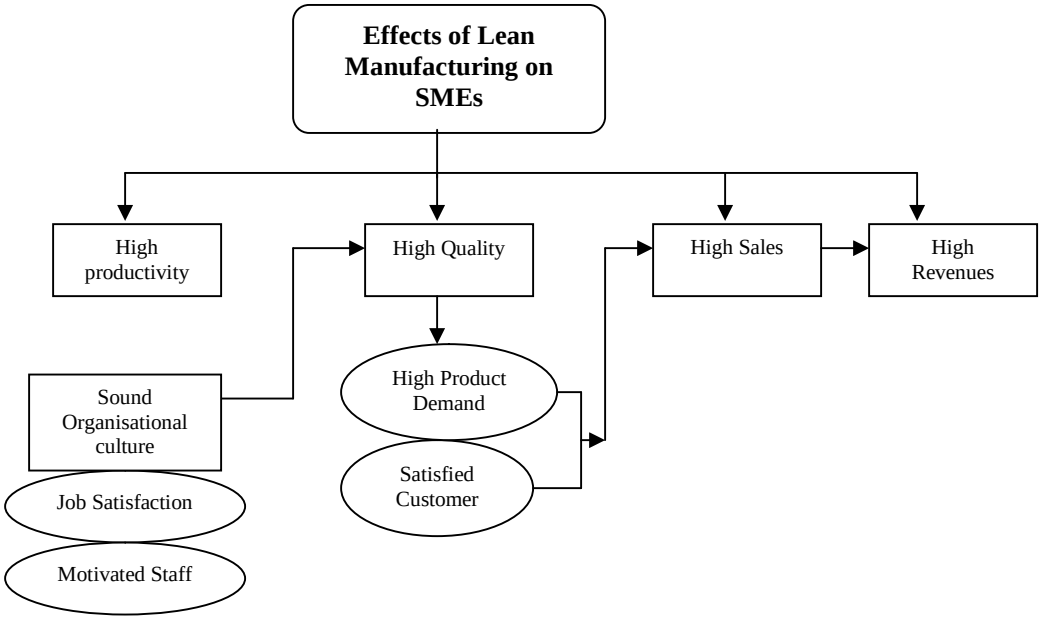

Figure 2. Research hypotheses

7. The investigated SMEs

Five SMEs who had successfully implemented LM in their business were investigated. These companies had various reasons for embracing the concept, but had some commonalities on the reasons that motivated them. For example, in one of these companies, the objectives were to continually improve the manufacturing facility. At the same time, they wanted to keep the cost of production down. The need to reduce lead-times, deliver on-time so they could remain competitive was the fundamental driver in all cases. In most instances, LM was implemented as a piecemeal on the department that needed urgent overhaul. Eventually, the concept was then gradually spread across enterprise. Members from production, material control, engineering, design and management (including their chairmen or managing directors) were involved. The total number of people involved depended on the size of the area that needed overhaul.

The implementation of LM within these SMEs in most cases followed a structured process carried out fragmentally. First and foremost, Manufacturing Specialists from the Manufacturing Advisory Service (MAS); a department of trade and industry initiative in the UK, were directly engaged to spearhead the project. MAS Specialist carried out an awareness session in order to promote the benefits of its initiation. Staffs were then alerted on the wastes in the organisations, and how they affected the business performance. Staffs were trained in VSM, problem solving and behavioural techniques. In most cases, the training was conducted offsite. This was to discard disturbances and distractions by people within the company who would have contacted anyone involved with the project for some other reasons. Again, it was thought that a new environment provides an ideal place for a refreshing mind. The trainings were continuous throughout the event – approximately 10-30 working days but on a fragmented basis between 4-5 days implementation blitz.

As it would be expected, change is never accepted outright. Employees did not trust the idea of lean implementation because to them it meant redundancies. This was overcome by further explanations of the lean value to the entire organisation and was facilitated by use of the JIT game. This worked well; because others had the opportunity to bring some useful ideas that no one expected. It also provided the opportunity for selling lean idea to everyone. JIT gave the best snapshot for employees to appreciate bottlenecks and their causes. As employees enjoyed it, there was provision for the project team to carryout selection of the required individuals. In the end, those who were not selected gave concessions since they appreciated why a particular employee and not the other, was selected to be part of the project. A multi-disciplined team of individuals across-function was then selected within the company for their various talents.

8. Results

Table (1) shows results achieved from the lean implementation project in the investigated SMEs. For confidentiality reasons, these companies have been abbreviated as (R, AM, RIT, DE and

AG). There were enormous tangible and intangible improvements in the functionalities of these companies. Tangibly lean manufacturing concept brought several benefits to those companies that were investigated, in terms of production output. For instance, one company that had struggled to cope with its very high customer demands as a result of sudden changes in customer requirements increased its unit of production from 4000 to 6000 units per week. The output of the line was almost increased by 50% more per week, which equates to approximately £120K worth of saleable product readily available. In most cases, the investigated SMEs were able to acknowledge returns on investments within a spell of three to four months. There were also some intangible benefits that the SME achieved. This could be viewed in terms of improvements in the process flow and staff motivation level. In another SME, lean manufacturing enabled the introduction of a high profile planning department which created a buffer for items that were only required for a particular job. The company indicated that by maintaining a low level inventory, inventory costs were greatly reduced. They also admitted having a reduced level of absenteeism dropped by 8% in 2004 against 2003 figures.

It can also be asserted that, the implementation of lean manufacturing across the investigated SMEs had some financial implications. Training costs and disruption to businesses are some of the notable issues. One of the investigated SME with an annual turnover of £3.5M and have 65 employs spent a maximum of £5k in implementing lean manufacturing. Considering that all these companies had enormous increases in their production output with shorter lead times, it can therefore be stressed that, lean manufacturing is an ideal tool for productivity improvement. In turn, improved production process generates high quality output that will be absorbed by the ever demanding customers. Consequently, high quality products will satisfy customers who will therefore be loyal to the producers. Ultimately, companies will generate high revenues that will keep their sustenance.

Table 1. Return on Investments

Investigated SMEs	Annual Turnover in (£s) millions	Volume of Production	Area lean applied	Duration of lean Implementation in days	Total No: of employees	No: of employees involved	Total spend Thousands (£s)	ROI (£s) millions	Reduction in lead-time from to: (Weeks)
1. R	3.50	L-H	P	10	65	13	5k	0.12	6-2
2. AM	4.00	L-M	P	15	98	50	4k	0.50	4-2
3. RIT	0.75	L	W	10	15	12	2.5k	0.05	8-3
4. DE	5.00	L-H	P	10	65	20	10k	0.40	4-2
5. AG	3.50	M	P	18	500	25	4k	0.55	6-2

Key: L=Low, M=Medium, H=High, P=Piecemeal, W=Whole, ROI=Return On Investments

9. Conclusions

This research project has contributed to the understanding of how lean manufacturing can enable a rapid response to an untimely demand changes. The empirical support provided from case study scenarios, demonstrates how lean manufacturing can transform the functionality of SMEs. All the investigated SMEs improved their productivity and lead-times to so they were e able to respond suddenly to their customer demands. This study is part of an on-going research project aimed at developing a framework for analysing the impacts of lean implementation; and also identifying fundamental issues organisations (SMEs), need to consider before making a decision on whether or not to adopt the lean concept.

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