

## Lean Manufacturing for SMEs: enabling rapid response to demand changes

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### **1. Introduction**

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

### **2. Literature review**

Previous research reveals that lean manufacturing 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 is only possible if they clearly comprehend real cost issues [2]. The use of lean manufacturing 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. lean manufacturing 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 might 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, the authors infer that lean manufacturing is a useful paradigm that provides organisations with the ability to manage unscheduled customer demands.

### **3. Methodology**

This study was conducted through various research mediums. A survey of published literature was carried out, which enabled the identification of current lean manufacturing 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 period in which a number of SMEs were visited to investigate their manufacturing and lean practises. Eventually, the study centred on five SMEs who have successfully implemented lean manufacturing within their 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 investigated how lean manufacturing transformed production flow, output, lead-time, and delivery-time in the SMEs. Semi-structured questionnaires, direct observation, and interviewing of key experts were used to collect data. Expert opinions, case studies, and workshops were used to verify the results. Data were also traced on the companies' performances before lean was introduced. This was later compared with the results following implementation of lean manufacturing.

## 4. Demand Changes

The pattern of demand for a commodity can change with the variations in price and the quantity supplied in the market [16]. To date, many providers have appeared in the marketplace, meaning that customers can make endless choices. Sloman [17] maintained that supply of products might also be determined by 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 lean manufacturing 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 i.e. 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 was the major breakthrough in Ruston, since the company's product flow system achieved a 50 percent increase in throughput with a 100 percent boost in on-time delivery [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.

## 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 the performance of SMEs.

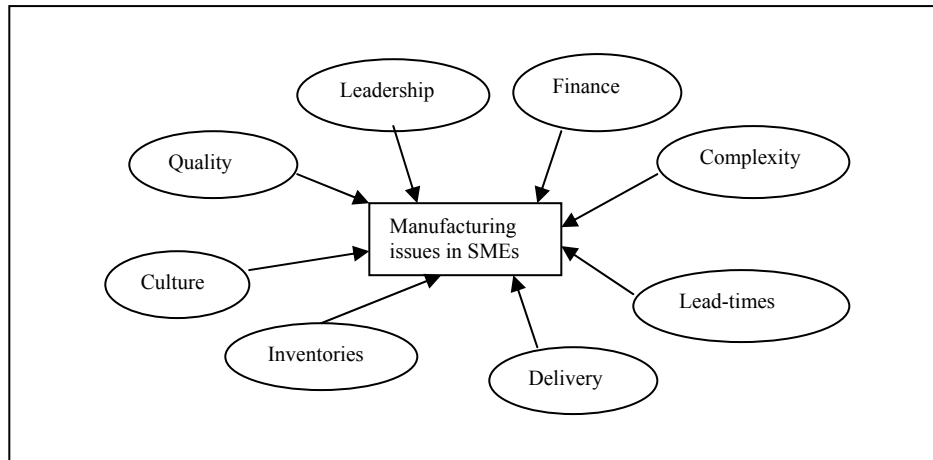


Figure 1 Manufacturing issues in SMEs

The ability to be led effectively is fundamental to a successful organisation [22]. Good leadership is a factor that enhances improved performance in any sector [23]. The 21<sup>st</sup> Century business environment has also 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]. SMEs are also 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 lean manufacturing 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. Solutions can then be sought while the pieces are put together.

## **6. Hypothesis**

This research has 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 because lean manufacturing dictates a sound corporate culture within organisations.

Creating a supportive organisational culture is therefore an essential platform for a conducive working environment [19]. In turn, it can be hypothesised that the entire workforce can become motivated by flexible working policies that provide job satisfaction. Employees are thus inclined to put excess effort in their quest to achieve maximum productivity.

As employees become satisfied with how they perform, the idea of them achieving defect-free units of production becomes an integral part of the system. The notion of internal competitiveness often occurs, whereby employees pit themselves against each other. Workers will therefore strive to be innovative and creative in their daily jobs, hence qualitative production.

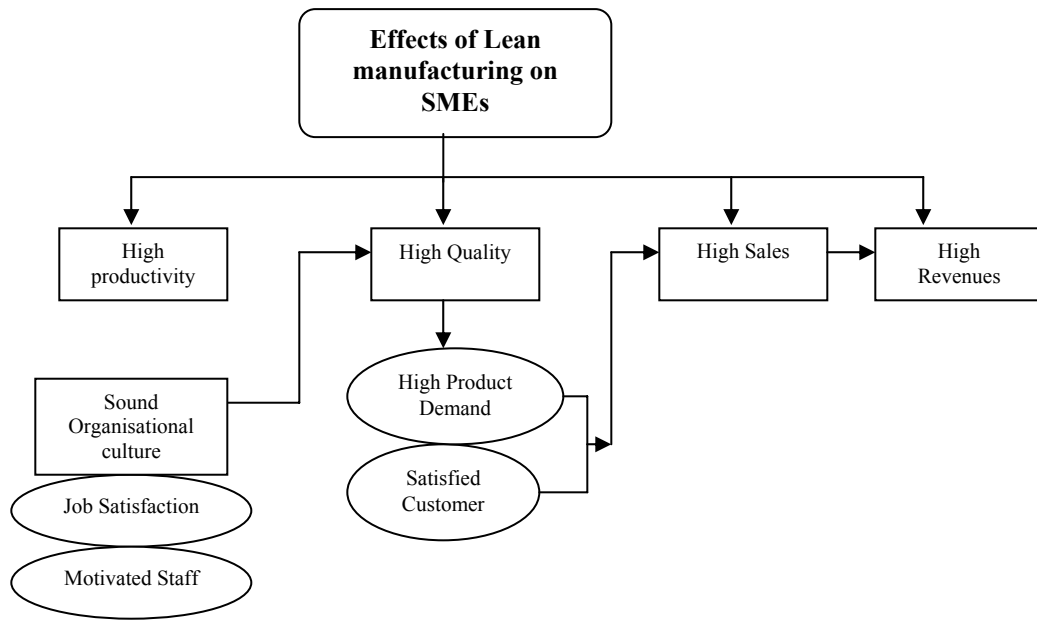


Figure 2 Research hypotheses

## 7. The investigated SMEs

Five SMEs that had successfully implemented lean manufacturing in their business were investigated. These companies had various reasons for embracing the concept, although they showed some commonalities. For example, in one of these companies, the objectives were to continually improve the manufacturing facility whilst simultaneously keeping down the cost of production. The need to reduce lead-times and deliver on-time in order to remain competitive was the fundamental driver in all cases. In most instances, lean manufacturing was implemented as a piecemeal on the department that needed urgent overhaul. Eventually, the concept was gradually spread across the 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 overhauling.

The implementation of lean manufacturing within these SMEs in most cases followed a structured process carried out fragmentally. First, 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. A MAS Specialist carried out an awareness session in order to promote the benefits of its initiation. Employees were then alerted to the wastes in the organisations and how they affected business performance. Employees were trained in VSM, problem solving, and behavioural techniques. The training was conducted offsite in most cases. 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. It was thought that a new environment provides an ideal place for a refreshing mind. The training was continuous throughout the event – approximately 10-30 working days but on a fragmented basis between 4-5 days implementation blitz.

As might 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, since others had the opportunity to bring some unexpected useful ideas. It also provided the opportunity for selling the lean idea to everyone. JIT gave the best snapshot for employees to appreciate bottlenecks and their causes. Since employees enjoyed it, there was provision for the project team to carry out 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-disciplinary, cross-functional team of individuals was then selected within the company for their various talents.

## **8. Results**

Table 1 shows the results achieved for the lean implementation project in the investigated SMEs. For confidentiality reasons, these companies have been abbreviated to R, AM, RIT, DE, and AG. There were enormous tangible and intangible improvements in the functionalities of these companies. The lean manufacturing concept brought several benefits to the

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. The SMEs also achieved some intangible benefits, which 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 that created a buffer for items that were only required for a particular job. The company indicated that inventory costs were greatly reduced by maintaining low inventory levels. They also admitted that absenteeism was reduced by 8% in 2004 against 2003 figures.

It can be acknowledged 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 SMEs with an annual turnover of £3.5M and 65 employees 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 suggested that lean manufacturing is an ideal tool for productivity improvement. In turn, an improved production process generates high quality output that will be absorbed by the ever-demanding customers. Consequently, high quality products will satisfy customers who may remain 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 Ng: of employees	Ng: of employees involved	Total spend Thousands (£s)	ROI (£s) millions	Reduction in lead-time from time 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 untimely changes in demand. 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 so they were able to respond suddenly to their customer demands. This study is part of an ongoing research project aimed at developing a methodology for analysing the impacts of lean implementation and identifying fundamental issues that SMEs need to consider before making a decision on whether or not to adopt the lean concept.

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