Maximising the Effectiveness of Introducing Advanced Technologies

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Abstract

In the face of increasing competition, manufacturing companies have to consider new methods of increasing the value of their products. Improved production efficiency to reduce costs, and higher product specification to raise levels of quality are needed to maintain existing business. It is often perceived among the inexperienced SMEs around the UK that investment in new technology and intelligent systems is the easiest, yet the most expensive, solution. However, this is often not the case when, and only when, a company undertakes extensive work to research, plan and manage technology implementation it is possible to select equipment which will enhance almost every aspect of a company's performance. However, without this work, new technology can not only confound a previously well organised operation but also incur high running costs and a long payback time. This paper outlines a generic approach to implementing new technology, identifies the keys to its success and how further sustainable growth can be achieved when new technology implementation is considered part of a company-wide strategy.

Keywords: New Technology, Intelligent Systems Implementation, Sustainable Growth.

1. Introduction

The increase in competition from foreign markets has forced manufacturing companies in the UK to establish new or unique competitive advantages to ensure that they can offer more value than just a narrow margin in total acquisition cost over the cheaper foreign alternative.

Many larger companies are successfully managing the change in requirements by taking on the characteristics that have made SMEs profitable in the past, namely; mass customisation [1], specific improvements in functionality and rapid development of new products and processes. However, they are still restricted by the rigidity of the organisation's structure and policies, hence it is important that while SMEs retain their traditional core capabilities and strengths, they must remain competitive by further improving on lead-times and product costs while maintaining high levels of quality and more advanced product designs..

In addition, a vital part of ensuring continued success and sustainable growth is to make the company not only an integral part of the customer's supply chain, but also a key part of the new product implementation procedure both for existing customers, and whenever possible those of the competition.

Underlying the achievement of these measures is the need for continued evolution in technological capability in order to enhance product specification and production efficiency. The degree to which reducing costs is more important than improving product quality, specification or delivery performance is a balance depending on each company's specific product, industry, customer base and competition. Continuous

redevelopment of a company's strategy and modifying its operational practices has to be based on these unique, distinctive requirements, the success of which depends on the degree to which the supply company is capable of meeting these demands.

2. 'Fit' Manufacturing

'Fit' manufacturing is a recently conceived manufacturing paradigm that is being constantly developed in an effort to encompass all of the characteristics of a manufacturing strategy.

'Fit' proposes an integrated approach to the use of Lean [2], Agility [3] and Sustainability to achieve a level of fitness that is unique to each company. 'Fit' does not only develop a company's latent potential to meet new market requirements, it actively encourages companies to seek new market areas and to operate in unfamiliar areas knowing that the technological, human and financial aspects of the company are robust enough to enable the company to achieve market breakthrough.

There are benefits inherently gained by implementing a 'Fit' system, which are seen firstly in terms of the operational metrics, but which also directly improve the product characteristics. A 'Fit' system actively promotes knowledge and skills alignment. Through the continual enhancement of a company's technology will come the need to ensure that a company's workforce is suitably trained. However, this does not extend simply into the manufacturing aspects of the company. Since 'Fit' promotes the continual development of new and innovative products in order to attract new markets. A company's design and engineering team must also be continually trained to meet market needs. This in turn brings new knowledge and understanding of the technology required and available, perpetuating the next stage of the company's development.

It is seen then, that in the context on new technology implementation, 'Fit' manufacturing is both a driver of, and driven by, improved capability and new opportunities. This is demonstrated in Figure 1, which shows how the direct value chain is supported by many other areas of business improvement, a few of which are shown. It is also representative of the fact that the different supporting functions contribute directly to the value stream, as well as managing the centrepiece of demonstrable improvement; that of new technology implementation.

One specific requirement for new technology employed within a 'Fit' company, must be to increase product and production flexibility through highly reconfigurable supply chains and manufacturing systems in line with the company's strategic position [4]

Reconfigurability is a key enabler in the 'Fit' paradigm and is not simply limited to readily adaptable machine systems but includes the need to reconfigure the complete company, its manufacturing system including its design system, technology, logistics, and supply chain [5] so that optimum responsiveness to customer demand is achieved. Therefore, the ability of a company to balance its demand requirements with its supply capabilities is critical to 'Fit'.

To achieve this, and hence maximise the effectiveness of the technology, the supply chain's constituent companies must be flexible enough to support the changing demands. Naturally this introduces an additional level of complexity to the project management of the technology implementation, which the authors suggest is best controlled as part of the 'Fit' strategy. As such, there is a further potential for improvement throughout the supply chain in terms of technology and knowledge transfer. Direct use of suppliers or customers skills, facilities and technologies improves working relationships and communication but most importantly exposes all parties to new contacts, industries and different tiers in a supply chain. This subsequently gives rise to new opportunities and promotes sustainable growth. If this were to be adopted across a whole industry or technology base then it could be seen that a particular group of companies, whether it be dictated by geographical location or relative product group, would gain a significant advantage in the worldwide market for their product.

3. Effective use of technology

Investment in new technology is often perceived as a way to achieve one-off step change improvements in a company's capabilities, providing access to new markets, new customers, increased sales and profits. However, it is often seen that poorly managed new technology can not only confound a previously well organised operation but also incur high running costs and a

long payback time endangering the very existence of the company!

It is only when technology becomes integrated to a company's daily operation that these problems will be overcome and equipment will start to return on its investment [6]. Further to which the more lucrative sustainable growth and business development occurs after the integration is complete, i.e. only when the understanding is good enough to work on more complex products or offer the facility as a sub-contract service.

It is clear then, that when investing in new technology these implementation and integration stages must be as short as possible and wherever possible take place before the money has been spent! An effective preparation and understanding of what the equipment has to do, and how the required results are to be achieved, will pre-empt many of the implementation difficulties that are normally experienced.

Obviously, technology that will benefit multiple products or processes, maximises the return on the investment, but as part of the work described above it is just as important to identify the effects on the processes that are not improved by implementation of new technology. If there are operations required to prepare a piece of work which can subsequently be completed twice as quickly, how must the preparation be improved to match that of the finishing operation?

There is also the additional opportunity of making new technology available to external users, either for manufacture of different product or for other companies to use themselves, renting the facility during unused shift time. This will have the effect of recovering investment more quickly and reducing ancillary costs such as power and property costs, all of which will make the original products more profitable. Could it even prove to be cost effective to buy and use production machinery in this way even though it does not directly increase production efficiency of the original product?

Questions such as this are a considerable part of the long term strategy for a business' growth which is closely linked to the skills and development of the individual areas of the business [7]. This conceptual strategy has to extend as far as five years to enable the understanding of the common goal and allow for much of the preparatory work described above.

This process is clearly laid out in figure 2, which demonstrates the relationship between some of the described elements of 'Fit' manufacturing and the effective use of a company's technological capabilities.

4. Case Study

Orangebox is a manufacturing company based in South Wales, assembling contract seating and office furniture. Over recent years it has experienced just the sort of increase in competition that has been described, and has sought to maintain its strong market position by offering a wider range of high quality products while controlling production costs through waste reduction and process improvements.

The areas of production common to each unit being produced are the foam manufacture, fabric cutting, some sewing operations, fixing of foam to fabric and an assembly operation which is unique to each unit but all dependent on a stores input.

Technological improvements have been implemented in each of these areas, in the following chronology:

1. Motorised turntables, automated mould heating systems and new foam machines.
2. Investment in a CNC cutting machine to cut digitised patterns from multiple layers of fabric, hugely reducing cutting time of cushion covers.
3. Continuous small improvements in sewing machine capabilities as specified by the development staff, who are seen to be increasing quality standards through introduction of new techniques and skills to the sewing operators. Also, the development of SMED achieved quicker and more responsive changeover times and assisted in rapid process reconfiguration.
4. Investment in MRP system.
5. Change to the gluing operation to use water based adhesive that does not need a long curing time or secondary finishing operations, which has been improved through investment in different gluing guns and extraction equipment.
6. Purchase of CAD facilities and training to bring the design facility in-house and

control product development. Opening a huge range of opportunities for new product development and introduction.

7. Development of the fabric spreading machine supplying the CNC cutting machine.
8. Investment in software to streamline the design-production interface for new cut covers and foam cushion development.
9. Bar-coding system to reduce the administration of the stores control and improve response times.
10. The technical development of local suppliers in order to achieve a agile and highly responsive supplier base which integrated with the reconfigurable systems development within the company.

It can be seen that the chronology of the improvements is a reflection of the changing attitude towards the development of the manufacturing operation. Innovation and the development of innovative concepts to achieve a lean technology implementation process are shown points 1, 5 and 7. A multi-disciplinary team was developed at Orangebox whose objective was to create an innovative culture towards process enhancement. Also, points 3, 5 and 10 show the move towards achieving rapid reconfigurability within the company through quick changeovers, process time reduction and improved supplier responsiveness.

Improvement 1 and 2 are the basic starting blocks of producing a chair, and improving these facilities efficiency resulted in large amounts of WIP as the subsequent operations had not been improved. Improvement points 3, 4 and 5 are the resulting requirements to make use of the improved facilities. These resulted in large gains in productivity, lower levels of stock-holding and cost reductions. Many **lean** practices including; Value Stream Mapping, 5S, TPM, Poka Yoke etc were used at this time to realise the improvements, as part of which re-organisation of the shop floor and operational workforce were required, making this step a lengthy process.

On the basis of having a more robust manufacturing system, point 6 opened the door to huge potential growth, strength in its own market and exposure to new markets gave the company truly **sustainable** development opportunities. Aggressive sales activity produced a boom in growth.

However, a combination of a slow-down in the market and limited flexibility forced Orangebox to focus again on its internal operation. Improvement points 7, 8 and 9 have been the missing parts of the jigsaw and have ensured that all improvements, past and future, can be maximised and more quickly and effectively implemented. They have provided the opportunity to reduce the time to market of new product, reduce the costs of special product and reduce batch size without compromising the efficiency of the batch process of foam manufacture and fabric cutting. In essence, points 7, 8 and 9 have increased the **agility** and flexibility of the company, while reducing the fixed costs of virtually every product.

The 'new and improved' Orangebox has developed a 'Fit' manufacturing system, and through the structure of the improvements made has facilitated virtually any improvement for the future. This tendency towards continuous improvement will now ensure that wherever a requirement is becoming evident, the knowledge and flexibility of the workforce will allow for reconfiguration or adaptation to prevent small issues needing the attention of management who are working on future improvements in technology to realise the next step change in business performance.

5. Conclusions

It is imperative that SMEs invest in new technologies and intelligent systems in order to improve their productive capabilities and product range whilst achieving reduced product costs and greater product customisability. It is through the development of new technologies that the service provided to existing markets can be enhanced , as well as enabling the company to compete in completely new higher value markets.

However, the implementation of such technologies will only be successful as part of a planned and controlled development programme containing clearly defined project management stages that have realistic project management targets as well as a comprehensive integration strategy where the technology fits effectively into the manufacturing system of the company. The result of such an approach will enable a company to achieve sustainable growth through a lean NTI process.

The flexibility and the reconfiguration of the working environment and the supply chain in supporting the NTI process is essential in order to help maximise the effectiveness of the new technology. Alongside this is the need to consider the issues of developing a Lean and highly agile manufacturing system as a result of such technologies. The achievement of manufacturing fitness should be the aim of companies investing in new technologies and its is suggested that the degree of effectiveness of technology implementation is correlated to the degree of fitness of the company. Therefore, if this is the case then 'Fit' can be considered as a driver for new technology implementation in a company.

The selection and subsequent implementation of new technologies is critical to a company's future sustainability. The selection of weak and ineffective technologies does not enhance company operations and incurs additional costs whilst the selection of technologies considered too advanced for a company limits its use and hence its return on investment. The selection of such technologies must be a business orientated decision and not purely an engineering or manufacturing issue. The development of a close working relationship between the key areas of a business and the technological requirements of a manufacturing process will dictate the degree of fitness of the manufacturing operation.

Recommendations

Further work is required to identify and characterise the key 'Fit' measures and how technology implementation and development impact on these measures and their relative effect on that particular company's manufacturing fitness levels. This in turn will help to define which areas require the greatest level of support and improvement, thus defining the investment strategy fir the purchase of new technology.

Acknowledgement

The MEC at Cardiff University is the lead partner of the Innovative Production Machines and Systems (I*PROMS) Network of Excellence funded by the European Commission under the Sixth Framework Programme (Contract No. 500273). www.iproms.org

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Figure 1. Integration of New Technology Implementation (NTI) to a successful 'Fit' organisational layout

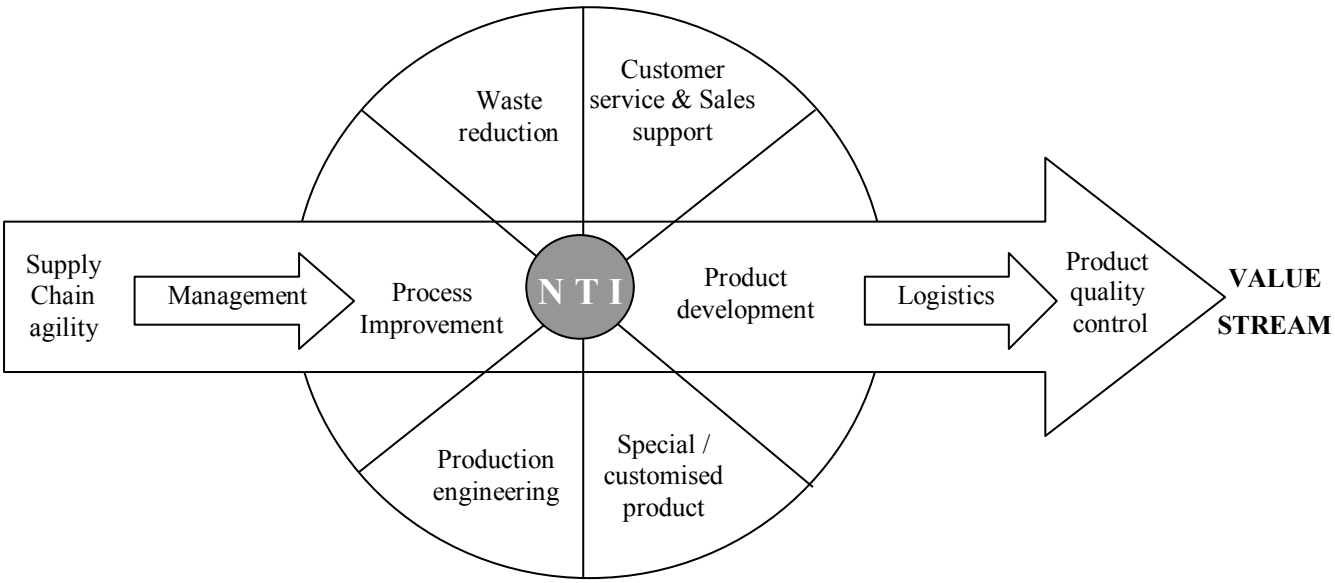

Figure 2. Flow chart demonstrating a successful implementation of new technology, leading to increased and subsequent new capabilities