

A Holistic Manufacturing Model for Company Development

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Abstract

In order for companies to remain competitive in an increasingly complex and demanding global market, they must discover innovative ways in which to manage their production operations effectively and efficiently whilst ensuring that new markets are penetrated and sustainable growth is achieved. Manufacturing strategies such as Lean and Agility allow companies to deliver bottom-line savings in production terms although their effectiveness depends upon the volume and demand profile of their products. The new trend towards mass customisation requires companies to provide personalised products and services at mass production prices. This now places a further burden on companies and therefore a holistic manufacturing framework must be developed in order to ensure that the factory of the future is able to meet this new demand. This paper proposes a Holistic Manufacturing Model (HMM) which integrates the manufacturing efficiencies achieved through Lean and Agility with the need to break into new markets through effective marketing and product innovation strategies to achieve long term economic sustainability.

Keywords: Lean Manufacturing; Sustainability; Manufacturing Strategy

1. Introduction

The EU manufacturing industry is undergoing major change. Pressures from mass customisation [1], overseas sourcing and the demands from ensuring Quality, Cost and Delivery targets are met are still the major hurdles that a company must address in order to remain competitive [2]. Recent global financial pressures have seen the complete demise or downsizing of major manufacturing companies in the EU. The decline of these companies has greatly impacted upon many EU supplier companies. As a result, these companies are now attempting to change their manufacturing focus and are looking to more financially buoyant and stable markets in order to survive.

However, the strategic shift to new markets is

not a simple process.

When dealing with long term customers, a manufacturing company is able to formulate clear and established methods to meet demand requirements based on a partnership approach between the supplier and the customer [3]. With the hunt for new markets, supplier companies are now finding that their manufacturing operations are not necessarily synchronised with the wider market sectors. The need to be Lean is a key requirement in industries where volumes are generally high, product complexity is low and the demand profile is relatively stable. However, in more volatile markets where demand patterns are now more sporadic and infrequent, companies need to become more flexible and responsive to a range of different customers.

Coupled with this is the need to identify accurately customer requirements quickly and effectively often without a mature partner - supplier relationship in place.

This paper outlines the problems and pressures that are faced by manufacturing industry today and advances the concept that whilst Lean and Agility may create opportunities to make a company more competitive through operational cost reduction, product flexibility, responsiveness etc, they are not designed to attack new market areas and seek growth and sustainability through product innovation and development. The paper goes on to develop the concept of manufacturing sustainability and then proposes a new holistic manufacturing framework as an approach that combines Lean, Agility and Sustainability to ensure a company prospers in this increasingly competitive environment. The intention of the proposed framework is to provide a mechanism for practitioners to integrate the key strategies of Lean and Agility and focus on the issue of creating sustainable manufacturing organisations.

2. The Need for a Sustainability Perspective

With the demand profile changing, companies must now operate in a less secure and more complex environment requiring their business and manufacturing strategies to cater for a wider range of requirements. Low cost, highly responsive and flexible product ranges are now an essential requirement in order to capture new markets and to become economically sustainable [4]. However, to do this, a company must be able to support its manufacturing operations by integrating the traditional strategic manufacturing requirements of Lean and Agility with business process strategies such as marketing and sales as well as technological and product innovation approaches in order to achieve a sustainable manufacturing environment [5] [6]. Figure 1 shows the effect on a typical company's economic sustainability by simply concentrating upon cost reduction strategies. Here it can be seen that without developing a strong and sustainable product portfolio to complement the lean initiatives, company sustainability is threatened and the onset of company failure is just delayed until

such time the drop in sales finally catches up with the operating costs and then the company becomes economically unsustainable. Figure 2 shows the effect of a combined approach towards waste reduction, responsive manufacturing and, pro-active product development and increased sales opportunities. Figure 2 shows the sustainability profile from such a proposed approach.

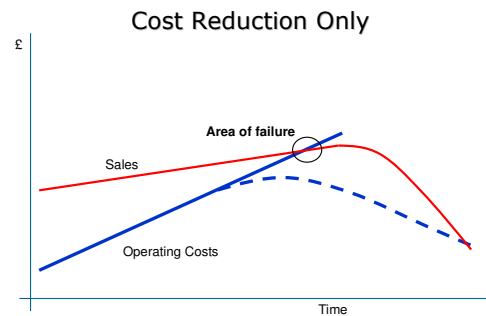


Figure 1 – Sustainability based on Cost reduction only.

3. A Holistic Manufacturing Perspective

Over the years many manufacturing strategies and paradigms have claimed to provide a 'total' solution to the manufacturing problem. In many cases, a solution to the efficient manufacture of products is achieved. However, rarely do the paradigms connect all the elements of a manufacturing organisation in order for that organisation to grow and prosper well into the future.



Figure 2 – Sustainability through combined approach

Lean and Agility provide an effective platform for the efficient manufacture of products. However, these paradigms concentrate primarily

on providing the 'capacity' for greater growth. Lean, for instance, encourages doing more with less: less space, less raw material, less energy etc. Agility promotes the need to be responsive and flexible to customer requirements and so, quick changeovers, time compression approaches etc are important issues. These paradigms suggest therefore that a customer base is available for a company to work with. However, what happens when a customer base collapses? How does a company cope with the vacuum left after such an event? Lean and Agility are then seen as somewhat secondary to the issue of penetrating new market areas that are often alien to a manufacturing company and often occupied by supplier companies with many more years of experience of operating in these markets. What is therefore required is a more holistic manufacturing strategy that enables a company to seek new markets and, more importantly, can give prior warning of major changes in current customer trends so that the company can adjust and move into new market areas quickly and effectively thus becoming economically sustainable in the process.

Sustainability means being able to achieve long term growth and prosperity in what is now an increasingly volatile and complex marketplace. In order to achieve this, companies must be able to operate effectively in more than one market area through penetrating a number of *high-value* manufacturing markets. In order to work in diverse market sectors, the company must have at hand the *technological platform* and *innovative culture* to break into these areas and have the confidence to operate in such environments. Moreover, a company must ensure that whilst its manufacturing operations are balanced to meet the demand chain needs, it is also critical that its supply chain is developed to the same extent thus ensuring there is a complete connection between demand chain and supply chain.

A company must also make effective use of their Sales and Marketing department. Often seen as 'one dimensional', this department can give advanced warning of customer and global trends advising manufacturing of any potential capacity issues when markets are buoyant and actively seeking new markets that the company's technological systems are capable of working

within when markets are slow. Also, sales and marketing can provide essential information of a product's positioning on its product life cycle identifying quickly when the product has finally started to move away from its maturity stage and into its decline stage thus triggering in advance a need to develop a new product or service.

It is therefore the *integration* of a company's manufacturing operations with its business strategy, its marketing strategy and its technological capabilities that is required to enable it to achieve sustainable economic growth. Kaplan and Norton [7] identify the need for a modern day company to consider a wider set of issues in order to remain competitive in the future. They state that for a company to grow and prosper in the 21st century there must be a more holistic view taken of the company operations rather than simply to concentrate on its manufacturing operations or its financial capabilities. Companies must now create future value through investment in customers, suppliers, employees, processes, technology, and innovation. Kaplan and Norton go on to identify four major perspectives a company must address. These are Financial, Internal Business, Customer and Learning and Growth

4. The Mechanisms of the Holistic Manufacturing Model

The proposed framework is an integrated approach to the use of Lean, Agility and other key business process strategies to achieve distinct and significant levels of manufacturing performance that is unique to each company. This framework 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.

The HMM allows a framework to be developed around issues that are important to the companies concerned. Whilst these dimensions form the framework for a systems approach to process improvement, it is important to ensure specific techniques and tools are available to help directly target improvements in the

manufacturing management and development process.

Figure 3. shows the development of a strategic holistic manufacturing model. This model highlights the key elements of the strategy and is split into three key stages. The *foundation* elements provide the company with the underpinning capability and mechanisms to introduce a holistic manufacturing concept. The *operational* elements provide clearly defined stages in which the company can facilitate, monitor and control the HM process [8]. The *enabling elements* allow the company to interface with the customer, these can be considered as the value adding streams of the business and the growth areas for the company.

Integration is critical to the HMM. Traditionally, companies have incrementally and systematically implemented various manufacturing paradigms (TQM, Lean, Agility etc) in a sequential manner as they become available or fashionable. This leads to an operational environment that is often left fragmented as individual systems are bolted onto existing infrastructures, usually causing internal conflicts within the company as the demands of one paradigm pull against those of another. These conflicts result in a significant increase in system and operational complexity as well as increased project costs and extended project timescales which, in turn, delay the benefits that can be gained from the application of a joint strategic approach [9].

Alongside this, the HMM identifies the need for effective integration of the technologies in order to implement and sustain change. This technology platform includes more than just the machinery and associated systems that convert the raw material into a finished product.

Over the years many companies have traditionally looked at relatively simple cost accounting approaches to monitor the health of their company. The HMM adopts an approach that also requires a company actively to build into their financial procedures two major aspects namely

- a) the need to link technological development and innovation into its cost accounting system.

- b) the need to tackle and amortise fixed costs through product/customer diversification.

On the first of these issues, the HMM proposes that companies actively plan for the continual upgrading of its technological platform by analysing how much of a company's profit is reinvested in new and advanced technologies. Through the continual upgrading of such technologies, new market areas can be defined and the confidence to operate effectively increases due to the knowledge that the company has the technical power to do so. Secondly, it is important that a company links and closely monitors its product's life cycle in accordance with the financial performance of the company. Closely monitoring the sales of a product will enable a company to identify early that a product is losing market share. This will enable a company to take corrective action by possibly introducing a new product to their range or enhancing the existing product. Product diversification can provide a company with an opportunity of 'splitting' its overhead and fixed costs into a range of different product lines or customers. Single product manufacturers have the problem that all fixed costs are channeled into one product and thus the weight of the complete company's costs are centred on one product line or customer. Having a wider product portfolio and/or customer base can alleviate this problem and allow for the amortising of fixed costs. If therefore one product fails to perform, it has less overall impact on the company.

Reconfigurability is a key enabler in the HMM 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 [10] 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 the HMM. However, regardless of how effective a company's ability to reconfigure, the process still takes time to achieve. It is therefore essential that a company is sensitive to customer trends and movements so that advanced warning is given to a company for it to be able to take appropriate action at an early stage.

Technology and Product Innovation: This is considered to be the cornerstone of the HMM approach. Here it is critical that a company has the required technological platform that is able to respond to the increasingly complex customer requirements. Also, the development of new and innovative products allows a company to break into new markets and also to stay ahead of its competition in mature market environments. It is through the effective integration of technologies that have the capacity to support the product innovation process that real market penetration can be made. The exploitation of new and advanced technologies is critical in today's manufacturing environment. Companies need to reduce product lead times, introduce new products more frequently into the market place and rapidly reconfigure their manufacturing systems as well as ensuring high product quality and low manufacturing costs [11] [12]. Technology therefore is a key facilitator in this 'time compression' process.

5. Conclusions

- This paper proposes a Holistic Manufacturing Model (HMM) specifically designed to meet the unique manufacturing and knowledge constraints of manufacturing companies. It aims to provide a holistic approach to manufacturing management in the future
- The systematic development of a technology oriented culture is important if EU companies are to survive within the global marketplace. Whilst the development of a specific Holistic Manufacturing model will obviously aid in the development of the knowledge driven culture, further work has to be done in order to ensure that this work is diffused throughout companies in the EU. Therefore, the adoption of the HMM and the associated rate of diffusion of such a strategy into companies requires further analysis and development [12]
- Refinement and the subsequent validation of the model will take the form of applying the model in test-bed companies. The results of such a process will inform of any changes that will be required in order to ensure the model achieves optimal effectiveness in a range of different types of manufacturing company.

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References

1. Pine, B. J II, [1993] 'Mass Customization - The New Frontier in Business Competition', Harvard Business School Press, Boston, Mass
2. Williams, B.R [1995] 'Manufacturing for Survival' Prentice Hall, London
3. Burgess, T.F. Gules, H.K. Tekin, M. [1997] "Supply-chain collaboration and success in technology implementation", Integrated Manufacturing Systems; 8, 5, pp 205-210
4. McCarthy, I. [2002] 'Manufacturing Fitness and NK Modeling', Proceedings 2nd International Conference of the Manufacturing Complexity Network, University of Cambridge, pp 27
5. 'UK Manufacturing – We Can Make It Better', [2000] Final Report, Manufacturing 2020 Panel. Foresight Manufacturing 2020 Panel Report. DTI, London
6. The Future of Manufacturing in Europe 2015-2020, The Challenge for Sustainability, [2003], EU FP6 Funded Programme.
7. Kaplan, R.S., Norton, D.P. [1996] 'The Balanced Scorecard: Translating Strategy into Action' Harvard Business School Press.
8. Salimi .B. [1996] "New product development in small high tech firms" M.Phil Thesis, University of Calgary.
9. 'Visionary Manufacturing Challenges for 2020', [1998], Committee on Visionary Manufacturing Challenges Board on Manufacturing and Engineering Design Commission on Engineering and Technical Systems National Research Council, National Academy Press, Washington, D.C.
10. Thomas, A.J., Webb, D. [2003], "Quality systems implementation in Welsh small- to medium-sized enterprises: a global comparison and a model for change". Proceedings of the I Mech E Journal of Engineering Manufacture, 217, 4, pp 573-579
11. Wainwright, C [1995] "Design: a missing link in manufacturing strategy", World Class Design to Manufacture; 2, 3, pp 25-32
12. Bessant, J., Haywood, B., [1988] "Flexible manufacturing in Europe", European Management Journal, 6, 2, pp 139-42.

Figure 3 The Holistic Manufacturing Model

