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Strategic planning, transfer and implementation of Advanced Manufacturing Technologies (AMT). Development of an integrated process plan

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Abstract

This paper concentrates on the planning requirements for the adoption of Advanced Manufacturing Technologies (AMT) in order to safeguard their successful implementation. Using the Cypriot manufacturing industry as a case study information is extracted regarding the implementation of Advanced Manufacturing Technologies. The research results are analyzed and are used in the development of a planning model for the acquisition of AMT. This model provides the framework for the correct justification and implementation of AMT to ensure Technical, Manufacturing and Business Success. It incorporates all the planning procedures and implementation parameters to be followed in order to ensure successful AMT adoption and implementation. It establishes the main reasons behind the successes or failures of the technologies and provides the methodology that can be adopted by the manufacturers to assist them in the justification and implementation of Advanced Manufacturing Technologies in their manufacturing environment. © 2002 Elsevier Science Ltd. All rights reserved.

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1. Introduction

1.1. Planning for the introduction of Advanced Manufacturing Technologies

The processes normally used to justify introduction of high technology machines, equipment, and systems into the organization, particularly in the manufacturing area, are proving to be one of the greatest impediments to success (Tippett, 1989). Recent Management theories stress the need for the manufacturing strategy of the business to be compatible with the firm's competitive strategy. Weill et al. (1991) point out that the most important common finding in all the field studies examining AMT is that decisions about AMT implementation should be part of a broadly based Business Strategy. Advanced Manufacturing Technologies are used to

revise completely the capability of manufacturing, improve manufacturing parameters and ultimately the company's order winning criteria. Lowe (1993) states that the competitive benefits of manufacturing innovation sometimes seem intangible to strategists. Their focus is usually on cost saving for operational reasons. Delivery, quality and control were all deemed important, but rarely seemed to be put in their strategic content. Goldhar and Lei (1994) point out that the adoption of AMT gives firms a greater number of growth options to enter new markets and to create new products than firms relying on traditional manufacturing technologies and generic strategies. In effect AMT change the external risk propensity of the firm from risk — averse to risk — prone. That is, firms using AMT in effect create a series of "call options" to enter new markets and industries in the future. A growing body of research in the manufacturing literature suggests that firms are investing considerable sums in Advanced Manufacturing systems in order to deal with fast changing products and fragmentation of traditional markets. AMTs are giving many

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firms the potential to bridge the chasm between choosing either low-cost dedicated production, or high-variety differentiation. Such technologies are enabling firms to blend small-batch and custom-order operations with the low-cost efficiency of standardised mass production (Sohal, 1996; Goldhar and Lei, 1994). Many recent studies of industrial innovation focus on batch manufacturing as the area in which AMT can have the greatest effect (Rush and Bessant, 1992). It is also indicated that the application of AMT can be successful in both high volume low variety production, and very low volume high variety production. The advantage of AMT is its ability to provide increased flexibility whereas the diffusion of previous generations of technologies was heavily influenced by the need for lower labour costs.

The reason most often cited for introducing AMT are cost reduction, increased flexibility, product quality and less tangible considerations such as a need to provide better managerial control, remain competitive, enter a new market or reduce dependence on an external supplier (Beaumont, 1997).

Advanced Manufacturing Technologies (AMT) operate in two powerful ways to affect competitiveness (Bessant, 1993), firstly by changing the price structure (more efficient processes through better use of inputs such as raw materials, direct labour and energy) and secondly through its impact on non price factors. These might include design and marketing related, production related, finance related and quality related factors. It is becoming clear that whilst price factors remain an important determinant of competitiveness, non-price factors are having a major impact in world markets. Whereas the diffusion of previous generations of technologies was heavily influenced by the need to lower labour costs, the advantage of AMTs is their ability to provide increased flexibility in terms of reduction in the cost of working capital, increases in the responsiveness of delivery, lower rates of rework and scrap, the ability to increase the customization of the products etc. Labour that previously appeared on the cost side now is seen as a vital resource. Thus, the decision for the adoption of AMT apart from its likely impact on unit costs must take into consideration the above factors that are much more difficult to measure (Chen, 1994).

The processes used to justify the introduction of AMT into the organization are proved to be the greatest impediments to success (Tippett, 1989). Accurate information concerning the benefits of AMT is limited and must be treated with caution, as we are in the early stages of diffusion. As a result, planning for AMT introduction is an essential but complex and difficult process.

1.2. Strategic justification of Advanced Manufacturing Technologies

This viewpoint accepts that every technology decision should have a strategic impact on the business. The need

for technological innovations in production processes should be initiated as a result of changing strategic or business objectives that require an evaluation of current production processes. Such evaluations might occur as a result of:

1. new product development,
2. rapid increases/decreases in demand for the firm's products,
3. the need to streamline costs,
4. the need to improve product quality,
5. changes in process technology etc. (Chen, 1994; Munro, 1988).

Vracking (1989) suggests that projects might have to be justified on the basis of strategic arguments. Arguments based on comparison with competitors, the retention, attainment or perception of industry leadership and expected future developments in the industry might serve as alternative factors for decision-makers to approve AMT projects.

Advanced Manufacturing Technology decisions should be justified by looking to see how manufacturing can give a distinctive competitive edge to the company. The strategic planning approach takes a long term comprehensive view of both business and technology issues. The firm should develop an integrated business plan that provides the vision and sense of direction for each organisational unit of the company to meet the strategic objectives (Kirton and Burnham, 1985). Companies should first identify the range of products/markets that are likely to be manufactured. In seeking to match products with technologies, management should be aware that adoption of AMTs, could bestow not only operational benefits such as improved quality, increased efficiency and shorter lead times, but marketing and strategic advantages as well. Benefits such as increased market share, reduced prices, improved responsiveness to changes in the market place, the ability to offer a continuous stream of customized products, faster product innovation and the improvement of the company's image have all been ascribed to the operation of flexible AMT (Chen, 1994). The product-market characteristics determine the company's order-winner criteria that the firm must possess in order to offer a competitive advantage to the company. On the other hand these order-winner criteria determine the level of the design and manufacturing parameters the company must possess. The desired level of these parameters should be the decisive factor in the type of AMT justification and introduction.

1.3. Defensive justification of Advanced Manufacturing Technologies

This viewpoint refers to the traditional approach by which the introduction of AMT is seen as an operational

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