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Advanced manufacturing technology transfer and implementation in developing countries
The case of the Cypriot manufacturing industry

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Abstract

This paper investigates the transfer and implementation process of advanced manufacturing technologies (AMTs) in developing countries using the Cypriot manufacturing industry as a case study. Specifically the paper addresses: (1) the management processes followed during the transfer of technology into the manufacturing environment, and (2) the steps followed both before and after implementation and productive operation of the technologies.

The results indicate that despite the distance between the manufacturer and the technology suppliers, no difficulties were experienced in acquiring information about the available technologies and the suitability of these technologies for the specific manufacturing environment. Preparations and human resource development prior to the introduction of the technologies were found, in general, not to be carried out at the level expected from the international literature to ensure successful implementation, but these problems were more effectively addressed after the introduction of AMT. In general, these deficiencies did not prove detrimental to the successful operation of the new technologies.

Keywords: Advanced manufacturing technology; Technology transfer; Technology implementation; Manufacturing SMEs

1. Introduction

The process of technology selection and transfer is very complicated and requires skills and managerial know-how. The process is also highly delicate and costly and as a result there is a need to put much effort and time into the transfer phase of AMT introduction into the organisation. Very often, the buyer of technology is in a weak position, especially when facing a stronger and more experienced supplier from an industrialised country. Djeflat (1988) suggests that the buyer can strengthen his bargaining power by following the steps outlined below:

- breaking up the technological package as much as possible;
- gathering correct information about the supplier and the product;
- using group buying; and
- avoiding any form of financing from the supplier.

Particular attention should be paid not only to the kind of AMT to be transferred but also to the type of contract to be used and the type of channel through which the technology should be transferred. There are two types of contract commonly used in the transfer of AMT. These are known as “turnkey contracts” and “product in hand contracts”. In the “turnkey contract” the whole implementation process is entrusted to a single foreign supplier who accepts the responsibility to implement the project of technology transfer up to the point where he hands the keys over to the client. In the “product in hand” contract the responsibility of the supplier is not limited to the equipment installation but also includes

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the initial management and operation of the equipment and training of the operators (Love and Walker, 1986).

Advanced manufacturing technologies can be imported through the following channels:

1. direct investments;
2. joint ventures; and
3. state controlled import modes.

The most commonly used modes are *direct investments*, and *joint ventures.* Under the *joint venture* category there are three types of technology transfer, based on the level and type of contribution of the firms (Djeflat, 1988; Edosomwan, 1988). These are:

1. supply of machines from the foreign firm;
2. supply of patents, licenses or manufacturing processes; and
3. supply of personnel to oversee the start-up of the machines and provide technical assistance.

The performance of companies using AMT depends to a large extent on how well they implement it and not on the technology itself. The way the technology is implemented has a serious effect on its performance and as a result on business performance (Ford, 1988). Weill et al. (1991) suggest that "changes in organisational structures and practices as well as worker skills and knowledge are needed for successful implementation of AMT". As technologies become more powerful and complex, the source of competitive advantage lies less in the particular hardware or software package purchased than in the ability to deploy it (Bessant, 1993).

The existence of a sound supporting infrastructure is characterised as one of the most important factors in successful implementation of AMT into the company (Love and Walker, 1986; Weill et al., 1991; Zahra, 1994; Swierczek, 1991). The organisational infrastructure can be split into two elements (Tippett, 1989):

1. knowledge, i.e. what the employees know; and
2. policies, i.e. the organisational rules, procedures, systems and structure.

The creation of an adequate infrastructure may require reorganisation of the company. However, the benefits that can be obtained through reorganisation, can in many cases be obtained independently of the introduction of new technologies (Rush and Bessant, 1992). There are many companies which managed to develop a competitive advantage just around their internal capabilities and their infrastructure even though their hardware (i.e. plant and equipment) were not exceptional. On the other hand, nobody managed to gain competitive advantage by employing technology on its own (Giffi et al., 1991). Bessant (1993) points out that benefits from AMT arise not only from the equipment and software used but also from changed working practices, skills disposition, interfunctional relationships, planning and control procedures.

As a general guideline three steps can be taken by the organisation to ensure that the firm's infrastructure will support effectively the introduction of AMT. These are (Tippett, 1989):

1. Acquisition of a thorough understanding of the present infrastructure, that is understand how the existing manufacturing processes are working. There are many companies which do not understand how they presently do their own business.
2. Rationalisation of current processes and identification of current foul-ups and bottlenecks. If these are fixed and work flow is smoothed out, the need for new systems may be reduced.
3. Definition of an infrastructure project plan. This should take into consideration all the existing supportive systems which must be modified, if necessary, to become compatible and supportive of the new technology.

There is no doubt that the human resource is the greatest asset for any organisation, without which the use and development of technology will not happen. Effort should be made so as to minimise the negative impact of technology on human beings in order to achieve successful technology implementation (Zahra, 1994; Swierczek, 1991). From the literature it is generally widely accepted that employees should be involved from the beginning by being updated about plans for new technology and the reasons why this new technology is needed. They should be aware of the impact the new technology will have on their job security, working conditions, promotion opportunities, job classifications and training requirements. Special emphasis should be given to the involvement of the workforce to the maximum possible extent in the selection and implementation of the new technology (Towers, 1986). It was suggested by Tippett (1989) that "companies seeking to achieve successful technology implementation found it necessary to introduce some changes in basic Human Resource Management (HRM) areas, and in the overall role HRM professionals play in the implementation process".

The main problems or reservations that may surface with regards to the attitudes of the workforce are:

1. fear of redundancy or job loss; and
2. fear of being unable to cope with the new system.

The above reservations can be resolved by guarantees of no compulsory redundancies related to the introduction of new technology and by continuous training (Love and Walker, 1986). Experience has shown that even in