

# ADVANCED MANUFACTURING TECHNOLOGY IMPLEMENTATION IN SMALL SCALE MANUFACTURING INDUSTRIES

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## ABSTRACT

*This research paper explains an in depth body of literature to inquire in to the factors effective on performance of firms implementing Advanced manufacturing technology (AMT). The aim of this analysis is to supply a comprehensive viewpoint of problems associated with roaring implementation of AMT and supply some directions to managers and investigators to create a corporation well-prepared to just accept new technological advancements. The factors are classified in to three classes technological, structural, internal or outside factors. A spread of pressures either domestically or globally encourage makers to become additional agile, responsive and versatile within the event that they wanted to survive. The literature showed that so as to own a fruitful result from AMT investment, the structure, culture, operational strategy and human resource got to be organized and integrated fittingly with one another to stay faraway from probable barriers or problems. Corporations that operate in developing AMT, fresh industrialized countries face lots of uncertainties once venturing in to the fashionable world markets [4]. Planned framework will be used as a suggestion for managers and investors in lifting up their AMT implementation system therefore, it absolutely was important for manufactures to own the flexibility to contend owing to the globalization altogether aspects of product producing like product variations, labor, market experience etc [9]. These enclosed massively enlarged competition and globalization of production process they served to position stress on a good set of value factors like style, product innovation frequency, and customization and delivery responsiveness [7].*

*The rise in each handiness and vary of AMT alternative disclose major opportunities not just for up substitution innovation however conjointly for radical alternatives. These opportunities have not been done before and do in ways in which weren't attainable past [15]. Changes in communication and interaction associated with AMT implementation are shown to end in larger satisfaction with the technology and AMT adoptions seem to be a key condition for long run aggressiveness. However, several AMT comes fail to fulfill the expectations of their adopters [11] and increasing signs of issue began to emerge that steered that the interpretation of potential advantages into real competitive advantage wasn't continually as straightforward as language a check for a brand new piece of equipment. In several cases not solely AMT investments are criticized for not yielding the specified results, however conjointly some researchers found a negative contribution of AMTs to the firm performance [2]. The researchers finished that the link between AMTs and firm performance contains a advanced relationship [28] and therefore the link is influenced by alternative factors, some governable and a few not governable.*

*These conditions give nice challenges to companies, which may have an effect on company strategic directions and alter business and producing ways. In an endeavor to survive underneath such conditions, firms area unit giving a strategic role to producing, from merely supporting promoting ways to taking part in a serious role in strengthening a company's market position [8]. The effective implementation of advanced producing technology is taken into account to beat this turbulent and hostile atmosphere. This feature is a very important resolution particularly for little and medium size firms [19] within which lack body and inadequate level of mean staff and engineers and don't seem to be attentive to the ways that within which AMT may be useful for them.*

*Thus, applying and adopting new technologies indicated that their area unit broader problems that ought to be thought-about. Management of companies that area unit considering the adoption of AMT got to acknowledge, perceive and address these problems so as to beat or circumvent the issues of previous installations. They need knowing what the structure and strategic factors area unit that create a firm additional competitive and adaptation victimization AMT in rising its performance and whether or not AMT's impact on company performance additional pronounced if related to a compatible structure style and human force and management practices. Attributable to high price and moderate-to high risk concerned in AMT investment, it's therefore vital for any organization to understand additional regarding these factors. Generally, the investigated factors may be classified as technological, structure and internal/external. This classification is illustrated in Fig. 1.*

*This study may be a step in paving the thanks to give an summary and steering in AMT adoption and also the correct mix of strategic and vital components that results in effective use of AMT in enhancing company performance.*

***Keywords: Advanced Manufacturing Technology (AMT), Computer Integrated Manufacturing (CIM), Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Computer Aided Engineering (CAE), Computer Aided Process Planning (CAPP), Computerized Numerical Controls (CNCS).***

## **I. INTRODUCTION**

In finding out AMT implications, the selection of AMT varieties and also their classification may be a call of crucial importance that ought to be created on the idea of existing theory and the nature of the analysis study to be conducted. Advanced manufacturing technology has totally different meanings in several things, however it is generally outlined as an automatic production system of individuals, machines and tools for the design and management of the assembly method, together with the acquisition of raw materials, parts, and also the cargo and repair of finished products [15]. Additional specifically, AMT is represented as a gaggle of computer-based technologies, together with Computer-Aided Design (CAD), robotics, Flexible Manufacturing Systems (FMS), Automated Materials Handling Systems (AMHS), Computer Numerically Controlled (CNC) machine or other automated identification techniques [25].

It is outlined advanced producing technology as a group of integrated hardware and software package based mostly technologies[27], that if properly enforced, controlled and evaluated, can improve the potency and effectiveness of the firm[2], used the term advanced manufacturing technology in their analysis to explain a range of technologies like CAD and Electronic Data Interchange (EDI) that primarily utilize computers to regulate, track, or monitor producing activities, either directly or indirectly. Additionally, many technologies or

programs like bar codes or cluster technology that don't directly involve computers are thought of to be AMTs since they're closely related to alternative AMT technologies. AMT has been classified in several ways that supported the automation and integration of producing activities



**Fig. 1: Contextual Factors Effective On Company Performance**

### 1.1 Levels of Manufacturing Activities

First level includes numerically controlled machine and robots referred to as complete machine tools or equipments that area unit controlled by self-contained computers. In level a pair of or producing cells a clustering of machines like group technology and versatile producing system perform a spread of tasks to supply a family of elements. In level three cells in level a pair of area unit connected to create connected islands through network of processed data like computer-aided design/computer-aided producing, automatic storage and retrieval systems. In level four all the producing activities as well as promoting of product area unit integrated through data network and shaped computer-integrated producing [12].

It is classified advanced technologies in the study by correlation analysis in two levels: initial level is Basic technology as well as software [28], Computer-aided manufacturing (CAM) and Direct numerical management. Next level is computer science or complicated technologies comprising vision systems, knowledge-based systems and decision-support systems [27]. Additionally classified AMTs as style technologies, like CAD and CAE that support product style and engineering; producing technologies, like CNC, CAM and AMHS that create production easier and faster; coming up with and management activities area unit expedited by the event of MRP, MRP II, electronic knowledge interchange and bar secret writing and Integration technologies like international intelligence agency, local area network (LAN) and enterprise-wide resource coming up with that permit a flow of knowledge and coordinated decision-making between functions among and between the corporations. Small and Chen [25] and Zhao [29] classified AMT into 3 levels supported quality, automation and integration of producing activities.

### 1.2 Classification of AMT Levels

Stand-alone systems include machine tools or equipment controlled by independent computers such as (computer-aided design and computer-aided process planning (CAPP) Intermediate systems contain a group of machines to produce a family of parts such as (automated guided vehicles (AGVS) and automated storage and retrieval systems (AS/RS) and Integrated systems which are connected to form linked islands through

computerized information network[1], for example (flexible manufacturing systems and MRP). In summary, Table 1 presents the classifications found in the literature.

It is affordable to state that almost all technological advancements that have modified the character of producing performance have taken place since 1950[4]. AMTs modify each economies of scale and economies of scope to be achieved while not dynamic the hardware and permit corporations to mix small-batch and custom-order operations with the inexpensive potency of standardized production [6]. The most important strategic advantages that these technologies supply area unit the hyperbolic flexibility and responsiveness, enabling a company to boost considerably its aggressiveness within the marketplace [2]. AMT has been viewed as a strategic weapon to realize competitive advantage, to boost productivity and performance, to boost quality of production [7] and reduce lead-time [3]. In result AMT changes the external risk propensity of the firm from risk-averse to risk-prone. That is, corporations victimization AMT in observes produce a series of decision choices to enter new markets and industries within the future [9]. It additionally was mentioned that even the advantages of advanced techniques like Just-In-Time are often complete with applying solely a couple of part of JIT and as a result corporations will bit by bit invest in these technologies to urge the foremost have the benefit of it [5].

**Table 1: Advanced Manufacturing Technology Classification**

Resource(s)	Dimensions
Boyer <i>et al.</i> (1996), Jonsson (2000), D'yz <i>et al.</i> (2003) (Swamidass and Kotha, 1998)	Design, Manufacturing, and administrative  Information exchange and planning technology, Production design technology, High-volume automation technology, and low-volume flexible automation technology
Small and Chen (1997) Small and Yasin (1997a, b) Sanchez (1996), Beaumont <i>et al.</i> (2002)	Stand-alone, Intermediate, and integrated systems Direct, indirect, and administrative
Meredith (1987) Ghani and Jayabalan (2000), Ghani <i>et al.</i> (2002)	Engineering techniques, manufacturing techniques, business techniques Stand-alone, manufacturing cells, linked islands, integrated manufacturing
Majchrzak and Paris (1995) Kotha (1991), Kotha and Swamidass (2000)	Integrated AMT , Non-integrated AMT Product design technologies, process technologies, logistics/planning technologies, information exchange technologies
Beaumont and Schroder (1997) Zhang <i>et al.</i> (2006) Waldeck (2007) Small (2006) Burgess and Gules (1998)	Direct, indirect, communication Design technologies, manufacturing technologies, planning and control, integration technologies Basic technology, artificial intelligence Stand-alone, moderate, and high complexity Hard technologies, soft technologies

Certainly, it takes some time for plants to realize the potential benefits of an AMT investment. It can be because of the learning curve associated with these technologies that may delay performance gains. As a fairly complicated technology, employees need extensive training and experience to master for new technologies. Therefore, time may act as a confounding variable in obtaining AMT benefits [10].

## II. OVERVIEW

Successful implementation of AMT involves the mutual adaptation of each the new technology to the organization and also the organization to the technology [21]. In truth the adjustment of technology to the organization and the other way around will ease the accomplishment of latest technologies and avoid management issues related to AMTs [27]. This importance embraces structure, culture and strategy of any organization.

## 2.1 Organizational Structure

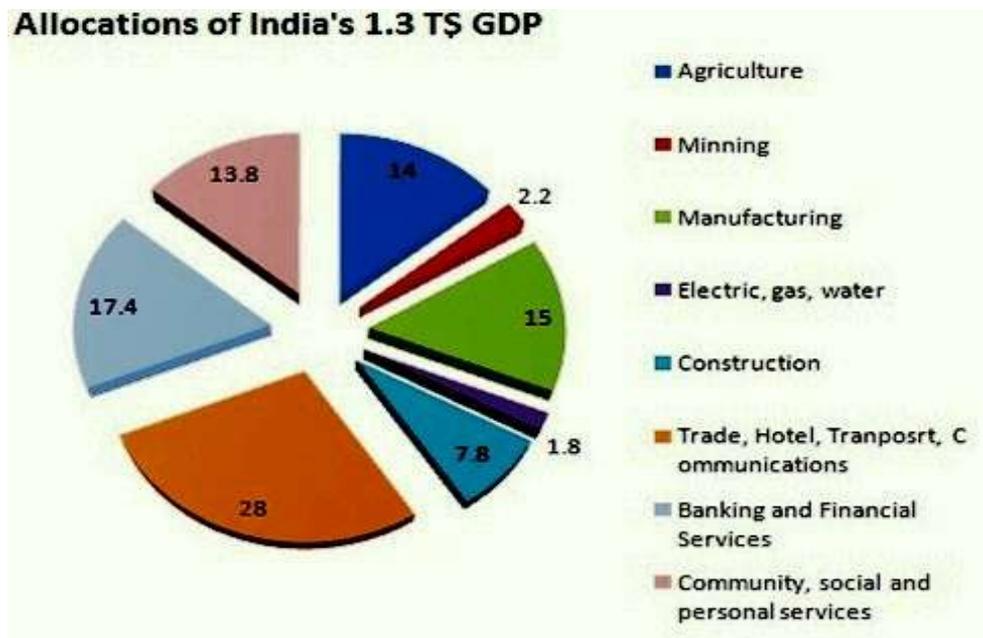
It has been argued that producing corporations that adopt AMTs while not initial redesigning structure structures and processes, encountering high difficulties. Beside AMTs emergence, industrial organizations have deeply modified their producing processes through the acquisition of processed technologies. This evolvement is often viewed because the basis for a brand new industrial revolution-the arrival of the mill of the future- and new type of structure [20]. Generally, structure of a company is that the formal system of operating relationships that share and harmonize the tasks of multiple folks and teams to serve a typical purpose. Centralization, systematization and complexness are the 3 dimensions typically use in analysis and observe to explain structure. Centralization within the organization refers to the delegation of power among the roles. The less power delegated in a company the larger the centralization within the organization and contrariwise. Systematization refers to the extent to that expectations relating to the aims and objectives of labor are given and written. Extremely formalized organization structures suggest what every individual ought to act supported rules and procedures that are gettable. Last dimension, Complexity, refers to variety the amount, the quantity of clearly totally different job titles or activity groupings and also the number of positively dissimilar units/departments, in an exceedingly organization [19].

The structure of the organization has been thought of because the key issue to with success implementing AMT in varied literatures [21]. It's theorized that the right structure is in this situation, an organization are going to be additional thriving in implementing advanced producing technologies [17]. Boyer [2] expressed that the multiple levels of authority involved graded organizations typically represent AN obstacle to the effective implementation of AMTs and streamlining the organization with fewer level of authority brings a larger ability to integrate AMT. They all over that rigid, official structure that has been related to extremely machine-controlled, however non-computerized producing systems like assembly lines, isn't acceptable for additional versatile technologies. It conjointly indicated that solely decentralization with fewer rules and additional worker involvement were completely related to technology whereas systematization and mechanistic structure interacted negatively with AMT. The results of this study emphasized that no matter the technology sort, a firm has to be as least mechanistic as doable to be effective. In examining the link between structure and AMT Ghani [8] found that, at high proactive level, the mechanistic structure of AMT plants has been found to vary into a body. If truth be told organizations with many alternative forms of jobs and departments generate additional difficult social control and structure issues than those with fewer jobs and units. Flatter, less complicated structures with most body decentralization, are additional doubtless toward making a possible for improved attitudes, simpler management, larger individual responsibility and company performance.

## 2.2 Organizational Culture

Successful implementation of AMT typically needs dissimilar forms of organization and or management practices than area unit found in additional ancient environments [14]. This is often as a result of new technologies directly challenge established norms and strategic choices. Structure culture named a holistic construct that describes the complicated set of information structures that organization members use to perform tasks and generate social behavior. This construct is full of and impacts several aspects of organization like structure, role expectations and description. Culture defines the way to act on the duty, that makes call in numerous things and the way to assume and behave toward coworkers, supervisors, trade norms and practices. This read of culture includes the organization's internal system of power together with formal authority

structures, management systems, task structures and organization rules [1]. In different word, culture is to the organization what temperament is to the individual, a hidden, however unifying topic that has that means, direction and mobilization [13].



**Fig 2 Overview of Manufacturing in India**

Generally the culture was image into two main dimensions as flexibility and management [8]. Flexibility-oriented culture is predicated on norms and values associated with the affiliation. It focuses on the event of human resources and values member involvement in deciding. During this culture, people are unit inspired by the many or ideological attractiveness of the task being undertaken. On the opposite hand, control-oriented culture is penetrated by assumptions of accomplishment like coming up with, productivity and potency. A lot of specifically, assumptions of stability are unit the muse of this culture and people relevance the structure mandates as a result of roles are unit formally declared and implemented through rules and laws.

Regarding to the result of culture on company performance, swamidass [31] hypothesized that the control-oriented approach may perhaps cause exaggerated productivity, however will hinder AMTs implementation, as a result of centralization of responsibilities diminishes opportunities for structure learning, which, in turn, will build a lot of difficulties to urge AMT up and running dependably. They complete that flexibility-oriented values can gain AMTs' productivity and adaptability advantages. McDermott and Stock [15] examined however structure culture is said to outcomes related to advance producing technology implementation, such as, operational advantages, structure or social control advantages, competitive advantages and satisfaction. They found that implementation effects that will take longer to happen, like overall satisfaction or competitive performance, did depend upon the cultural flexibility. Chan [5] tried to seek out the connection between structure culture and sure-fire implementation of AMTs in Taiwan. Analysis showed that the control-oriented culture did end in reduced AMT implementation success whereas smart internal method, rational goals and horizontal coordination have positive result. Results incontestable that firms with a history of sure-fire AMT implementation most well-liked a flexibility-oriented culture during a lot of contributing surroundings to ease the AMT implementation Yusuff [30].

### 2.3 Operational / Manufacturing Strategy

Basically, the importance of producing strategy to the success of the corporation has received goodly attention as Skinner printed his landmark article in 1969, manufacturing-missing link in company strategy [7]. In keeping with the new approach to producing strategy, managers ought to deem investments a lot of in their capability to make new capabilities that give enduring sources of competitive advantage and are sometimes engineered over time through a series of investments in facilities, human capital and information. The first approach to producing strategy led high managers to focus their firms operations around specific competitive priorities that cared-for create them at risk of strategic shifts. A decent producing strategy was one that defended a company's position through a narrowly centered set of capabilities [11]. In different words, strategy was denoted as actions or patterns of actions meant for the accomplishment of goals. The term strategy covers quite simply meant or planned strategy in associate structure setting; it additionally contains the sequence of call that exhibit a post consistencies in decisional behavior [31].

There is general agreement that a firm's operations/manufacturing strategy is comprised of 4 key competitive priorities: value, quality, flexibility and delivery [3]. Value strategy relies on the assembly and distribution of product at lower value. It's a live of the producing function's potency and historically it's been related to high volume/mass production. Quality strategy is related to a firm's ability to supply superior product or services, usually at higher costs. Delivery strategy is outlined with on-time delivery schedules and quickly response to client orders. Flexibility could be alive of a firm's ability to react to promote demands by shift from one product to a different through matched policies and actions and react to changes in production and merchandise combine, modifications in style, fluctuations in materials and changes in sequence. The effectiveness of a company's operations strategy is that the operation of degree of linkage or consistency between the competitive priorities that are stressed on the corresponding choices relating to the structure and infrastructure of operations [15]. The stress placed on these priorities varies by corporations, looking on an outsized range of things as well as accessibility of resources, business strategy, existing capability, social control behavior, nature and intensity of competition and status [20].

One of company's most vital variables for addressing environmental uncertainty is flexibility that's notably relevant to the speedily ever-changing conditions poignant producing organizations. This is obscurity a lot of actually than for AMT that provides the most important supply of flexibility in any producing organization [2]. It's been noted that though AMT creates a world of opportunities, they'll not be regenerate to advantage unless the adopting firm uses a strategic coming up with approach. Swamidass [31] conducted associate empirical study to search out the link between operational strategy and performance. They found that environmental uncertainty like producing flexibility and also the role of producing of producing managers in strategic deciding influenced manufacturing strategy and among completely different dimension of producing strategy, flexibility features a sturdy relationship with business performance. Zhang [29] declared that AMT implementation is a lot of associated with quality and delivery strategy. Results from Boyer [2] showed that among the two teams in their sample (high performers and low performers) in applying AMTs throughout the last three years, high performers typically were a lot of doubtless to worry on flexibility, quality and delivery strategy than value strategy and specifically the foremost dramatic distinction appeared with relevance quality strategy between the two teams. Different researchers believed that every one four producing strategy dimensions are necessary in implementing new technologies and gaining connected advantages [12] and specializing in one dimension doesn't relate on to AMT performance. The concurrent accomplishment of value, quality, delivery and

adaptability by several Japanese firms has highlighted this new risk that may be complete by adopting advanced method technologies and management techniques [30].

## **2.4 Human Resource and Management Practices**

Along with technology development, the human resource is Associate in resource quality for any organization, while not that the employment and development of technology won't happen and has vital impact on strategic success. Human resources qualities, attitudes and behavior will give the firm with a supply of competitive advantage with reference to its rivals [25]. Researchers emphasize the importance of providing applicable manpower development activities like socialization ability Chan [5] and manager's involvement in R and D comes to boost skills and relative needs ensuing from modifications in technology and new production processes in enhancing company performance. Inherently, all AMTs can increase employee needs as staff area unit given additional autonomy over problems together with designing and drawback finding [16]. Proof from the literature recommended that designing Associate in implementation activities aimed toward making ready staff for AMT adoption play a crucial role in guaranteeing an exploitation of the system edges. Thus, a serious challenge for future winning implementations lies in addressing the wants obligatory by AMT on the human components.

In order to show staff into key components for building a competitive edge, folks need to be managed in a very distinctive means and being additional capable in terms of information, skills, attitudes and responsibility [23]. As a result, providing staff with opportunities to boost their inherent motivation and job satisfaction by suggests that of employee-involvement practices may well be deemed a suitable policy to ally the goals of workers with the company's victimization AMTs [14]. Education and coaching are crucial to the winning implementation of AMT. expertise has shown that between twenty five to four-hundredth of the whole price of an intensive winning automation project ought to be spent on education and coaching [29]. Companies with winning AMT implementations conjointly enlist champions. These people support a continuous drive throughout the initiative. The consequences of those 3 practices beside the opposite seven factors were tested on ERP systems in some Malaysian firms and therefore the results showed their importance in real things. Widening of the marketplace, increasing importance of technology and imperative of innovation and specializing in cross-functional teams, area unit applicable ways in which to develop viable business solutions [7]. Thanks to the importance of the management personal characteristics, expertise and background on their selections, any amendment has got to begin with the managers on the highest and within the middle, then the organization of staff on the work. Besides, to facilitate the psychological, physical and cultural amendment ensuing from AMT implementation, management should build trust and co-operation [12]. These practices will receive the accomplishment of technology investment comes.

## **III. CONCLUSION**

A comprehensive analysis on AMT consistently builds upon past researchers so as to guide investigation into the triple-crown AMT implementation and to work out those most crucial structure and strategic parts that will create a firm ready to use AMT in enhancing performance. To analyze Technological capabilities that will be strategically accustomed, accomplish property with competitive advantage and also the implementation of those technology is associate structure transformation method, during which labor price, structure , culture, competition strategy and arrangement of individuals all can amendment to compatible with one another. The

key to triple-crown AMT implementation seems to be the collaboration of acceptable factors and their integration which will supply most advantages from AMT implementation. To gain fundamental insight into the framework which will present the intra/inter-relationship among the variables influencing company performance in parallel with technology utilization that may be analyzed and offers testable propositions? This research suggests that utilization of AMT won't additionally necessary issue that guarantee performance however any need acceptable changes within the firm's structure and infrastructure can and continue with performance appraisal to enhance company capability. To implement intra/inter relationship framework for manufacturing process.

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