



## EXTENT OF USE OF ADVANCED MANUFACTURING TECHNOLOGIES (AMTs) IN NORTHERN INDIA MECHANICAL MANUFACTURING INDUSTRY

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### ABSTRACT

In today's highly dynamic and rapidly changing environment, manufacturing scenario has undergone a rapid change in the last two decades, more so in the last few years. The manufacturing units are continuously trying to update themselves by acquiring or developing new technologies. The objective of this paper is to find out the extent of use of various advanced manufacturing technologies in northern part of India's mechanical manufacturing industry. It was found that CAD and NC/CNC/DNC machines are being used widely in design and fabrication related advanced manufacturing technologies respectively.

**Key words:** *Advanced Manufacturing Technologies (AMTs), Extent of Use, Indian Industry.*

### 1. Introduction

With the liberalization and globalization of today's economy, a lot of pressure has come on the organizations in developing countries especially in India to perform better in the coming days. This is because that company has improved their technological status by implementing AMTs through joint ventures or licensing agreements. Today's manufacturing environment can be characterized by intensified competition, rapid market changes, increased product variety and short product life cycles. In order to be competitive, manufacturing enterprises need to respond rapidly to product demand changes. Today, most organizations share access to same manufacturing processes, systems etc. The competition is therefore no longer based on manufacturing technology as such, but rather on how well the organization manages the technology relative to its customers. Management of technology is defined as "managing technology means to use new technology to create competitive advantage" [1].

The purpose of this study is to explore the extent of use advanced manufacturing technologies in Indian mechanical manufacturing industry. The focus of the study is on large and medium scale manufacturing enterprise of Northern India, because these are the organizations who are implementing these AMTs. As per existing definition, large scale manufacturing enterprise in India is defined as an industrial undertaking in which the investment in fixed assets (in plant and machinery) does not exceed Rs1000 million; whether held on ownership term or lease or on hire purchase and for medium scale enterprise the limit is

Rs. 100 million in fixed assets (in plant and machinery). The next section defines the concept of AMTs; as explained by different scholars.

### 2. Literature Review

The word 'Technology' has been derived from the Greek word 'Techno-logia'-Techno means an art or skill and 'Logia' means science or study [2]. Different people view technology from different angles; it carries different meaning to different people in different situations. Technology is defined as, "the practical knowledge, know-how, skill and artifacts that can be used to develop a new product or service and a new production/delivery system" [3]. Technology directly influences success and growth of business enterprises; and economic growth and wealth of nations. The pace of change has never been so rapid. Newer technologies arrive frequently and markets evolve constantly, forcing organizations to change their work culture. In this fast moving environment, the major objective should be to keep people up to speed with change, increase productivity and find new ways of offering a competitive advantage.

Noori [4] has defined advanced manufacturing technologies (AMTs) as new technologies which are used directly by the firm in the production of a product. In the past twenty years, AMTs have been widely used by manufacturing companies all over the world. However, world-wide research found that not all AMTs perform as expected. It was found that CAD, MRP, LAN, and CNC machines are the most popular AMTs used now as pointed out by Sun [5]. Moreover, AMTs

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can be described as a group of computer-based technologies, including computer-aided design (CAD), computer numerical control (CNC) machines, direct numerical control (DNC) machines, robotics (RO), flexible manufacturing systems (FMS), automated material handling systems (AMHS), material requirement planning (MRP), manufacturing resource planning (MRP II), enterprise resource planning (ERP), activity-based costing (ABC), and office automation (OA) [6].

Advanced manufacturing technologies (AMTs) have appeared to represent a perfect marriage between technological potential and the manufacturing challenges [7]. Past research has described advanced manufacturing technology as a multi-dimensional construct that includes the use of ‘hard’ machine related aspects: robotics, CNC hardware, CAD/CAM, etc.; and ‘soft’ reduction techniques, JIT, etc. [8].

Swamidass and Kotha [9] have classified AMTs depending upon their four dimensions. These are as follows: - product design technology (PDT), process technology (PT), logistics/planning technology (L/PT) and information exchange technology (IET). PDT includes the technologies related to product design, such as CAD, CAE and so on. PT is utilized in the front line for production process. L/PT includes the technologies related to material flow from raw material purchasing to delivering products, e.g. MRP. IET includes all the information exchange and storage in above three technologies.

AMTs have been classified as stand-alone systems, intermediate systems and integrated systems by Small and Yasin [10]. Technologies such as CAD systems are typically categorized as stand-alone systems. Automated inspection, automated material handling systems and computer numerical control machines (CNC) are classified as intermediate systems. Integrated technologies can be categorized as either: integrated process technologies or integrated information/logistic technologies.

Many researchers, scholars and practitioners have carried out significant work in the area of advanced manufacturing technologies. Most of above mentioned AMTs are being used in the Indian manufacturing industry as depicted in Table 1.

**Table1: Classification of Advanced Manufacturing Technologies in Indian Industry**

Design	Fabrication
CAD;CAE and CAPP	NC/CNC/DNC; FMS; AMHS; Robotics and CAI/T

### 3. Research Design

The manufacturing units in Indian manufacturing industry are continuously trying to update themselves by acquiring or developing new technologies. The present study has been carried out in the medium and large scale manufacturing organizations in the northern part of the country that have implementing advanced manufacturing technologies. A database of 530 large and medium large scale organizations of Northern Indian mechanical manufacturing industry was created; which contains: name of company; location; main products; type of industry; and their postal addresses. The target companies were selected from the following two sources: (1) The Confederation of Indian Industry (CII); (2) Directorate of Industries. A final structured survey questionnaire developed on four-point Likert scale i.e. (1-Not at all; 2-To some extent; 3-To moderate extent and 4-To a large extent) has been mailed to 400 members chosen at random from among the membership of the Confederation of Indian Industry (CII) and Directorate of Industries. (See Appendix I) Most of the respondents to “AMTs Questionnaire” belonged to the top brass of management executives that included Vice-Presidents (VC), Head-Operations, General Managers (GM), GM-Technical, Quality Managers, Manager-Quality Assurance (QA), Managing Director (MD) etc. 95 responses were received, constituting a response rate of 23.75%. The breakdown by organization is shown in Table 2.

**Table 2: Breakdown of Responses by Organizations**

Type of Company	Medium Scale	Large Scale
	60	35
	60/95=63.16	35/95=36.84
Number of Employees		
<300	32	01
300 to 800	24	07
801 to 1500	04	04
>1500	00	23
Present Turnover (Rs in crores)		
<100	44	00
100 to 400	14	11
401 to 800	02	07
>800	00	17

#### 3.1 Extent of use of design related advanced manufacturing technologies

In this design related advanced manufacturing technologies; computer-aided designing (CAD); computer-aided engineering (CAE) and computer-aided process planning (CAPP) has been incorporated. Fig. 1

shows that this CAD technology is extensively used by the organizations; whereas only 10% of the organizations do not use it. Around 28% of the organizations say that they do not use this CAE technology. Similarly, 35% of the organizations say that they do not use this CAPP technology. It can be concluded that CAD is most widely used technology in design related AMTs. Fig. 2 shows that around 45% of organizations used design related AMTs in their organizations.

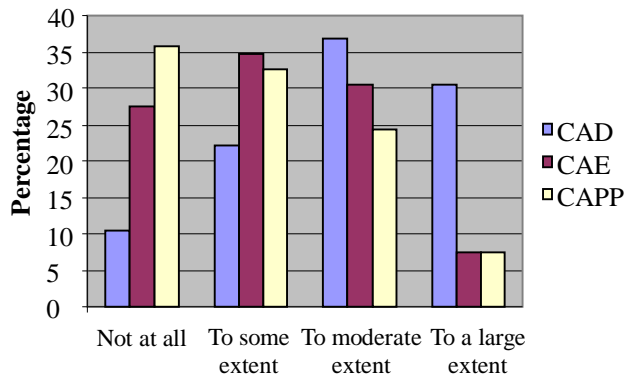


Fig. 1 Extent of Use of CAD, CAE and CAPP Technologies

### 3.2 Extent of use of fabrication related advanced manufacturing technologies

In this fabrication related advanced manufacturing technologies; NC/CNC/DNC, flexible manufacturing system (FMS), automated material handling system (AMHS), robotics and computer aided inspection or testing (CAI/T) has been included.

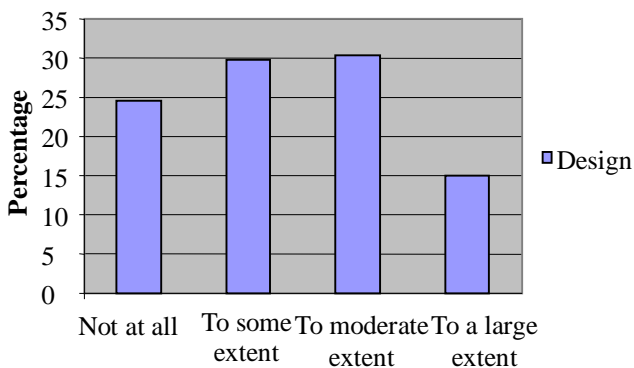


Fig. 2 Extent of Use of Design Technologies

Fig. 3 shows that 55% of organizations used the NC/CNC/DNC machines in the organizations from moderate to a large extent; whereas only 19% of the

organizations do not use it. Around 70% of the organizations say that they do not use this robotics technology. Similarly, 30% of the organizations say that they do not use this CAI/TP technology.

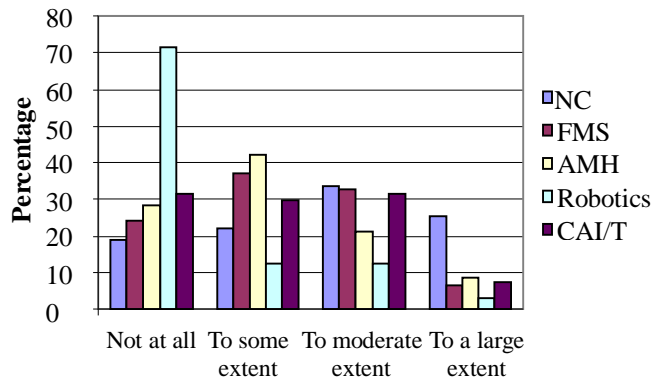


Fig. 3 Extent of Use of NC, FMS, AMHS, Robotics and CAI/T Technologies

It can be concluded that NC/CNC/DNC is most widely used technology in fabrication related advanced manufacturing technologies. Fig. 4 shows that around 35% of organizations do not use this fabrication related advanced manufacturing technologies.

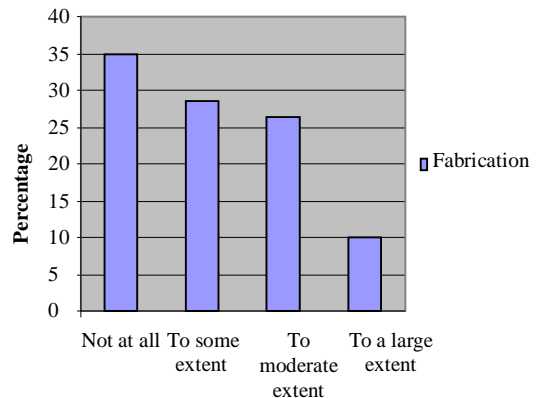


Fig. 4 Extent of Use of Fabrication Technology

### 3.3 Extent of use of design and fabrication related advanced manufacturing technologies

Fig. 5 shows that 35% and 25% of organizations do not use this fabrication and design related advanced manufacturing technologies. Whereas 65% and 75% of the companies used fabrication and design related advanced manufacturing technologies from a very small extent to a large extent. Still manufacturing industry in India is not using these advanced manufacturing technologies to a very greater extent. To survive in this competitive world, they have to think over it.

### 4. Conclusions

The research highlights the extent of use of various AMTs in the Indian manufacturing industry for accruing strategic benefits for meeting the challenges posed by global competition.

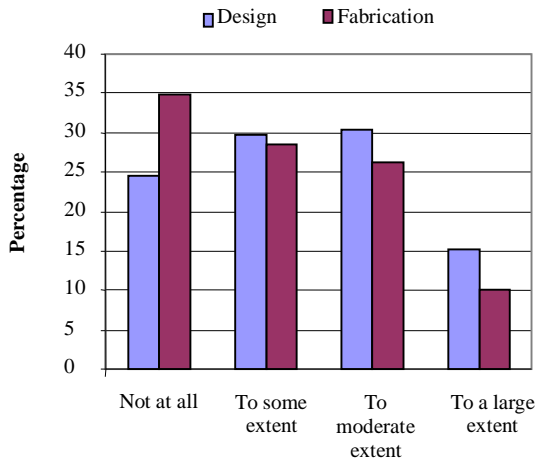


Fig. 5 Extent of Use of Design and Fabrication related Advanced Manufacturing Technologies (AMTs)

The study reveals that design related AMTs are being used more commonly as compared to fabrication related AMTs. In design related technologies, computer-aided designing (CAD) is being used extensively as compared to other advanced manufacturing technologies (AMTs). In fabrication related technologies, NC/CNC/DNC machines are being widely used as compared to other advanced manufacturing technologies (AMTs) of fabrication.

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### Appendix

#### Appendix I (Questionnaire)

##### General

Name of Company				
Address of Company				
Respondent's name and Designation				
Main product(s) of the Company				
Accreditations/Certifications of the Company				
Type of Company	Medium Scale		Large Scale	
Number of Employees	<300	300 to 800	801 to 1500	>1500
Present Turnover (Rupees in crores)	<100	100 to 400	401 to 800	>800

Please indicate the extent of use of following advanced manufacturing technologies (AMTs) in your company.

S.No.	Type of Technology	Extent of use of following technologies			
1	CAD	1	2	3	4
2	CAE	1	2	3	4
3	CAPP	1	2	3	4
4	NC/CNC/DNC	1	2	3	4
5	FMS	1	2	3	4
6	AMHS	1	2	3	4
7	RO	1	2	3	4
8	CAI/T	1	2	3	4

CAD-Computer aided design; CAE-Computer aided engineering; CAPP-Computer aided process planning; NC/CNC/DNC-Numerical control/Computerized numerical control/Direct numerical control; FMS-Flexible manufacturing system; AMHS: Automatic material handling system; RO: Robotics; CAI/T: Computer aided inspection/testing.

