

# Implementation of Advanced Manufacturing Technology in Small and Medium Scale Enterprises

Lalit Taank, S.K. Jarial



**Abstract:** This paper reports the findings of small and medium scale Indian manufacturing industries. The report included four different industry sectors, i.e. automobile, electronics and electrical, manufacturing sector and processing sector. Responses from 242 industries are analysed and presented in this paper. It is observed that Indian industries invests more in 'Manufacturing AMT' rather than 'Design AMT' or 'Administrative AMT' to make the production system simple; 'Design AMT' is the second choice to join together the various systems, and finally to automate the manufacturing systems the companies are investing in 'Administrative AMT'.

**Keywords:** CAD, MRP, CNC, AMT, Design AMT

## I. INTRODUCTION

AMT seems to speak to ideal wedding involving mechanical prospective and manufacturing difficulties. AMT alludes to manufacturing process technology that utilize PCs to store and control information. Advanced Manufacturing Technology is covers a wide range of Computer controlled mechanized procedure innovations [1]. AMT is used to portray a wide scope of mechanization and related advances, which have risen through the most recent two decades as a result of improvements in information technology [2], [3]. Explicitly, Advanced Manufacturing Technology can be depicted as a gathering of Computer based innovations, including CAD, CNC machines, DNC machines, Robotics, FMS, Automated Material Handling Systems, Automated Storage and Retrieval System, AGV, Rapid Prototyping, Bar Coding, Material Requirement Planning, Manufacturing Resource Planning, Activity-Based Costing, Enterprise Resource Planning and Office Automation[4]. Advanced Manufacturing Technology can contribute in the direction of accomplishment of each and every manufacturing goal, that is, cost, quality, time and adaptability [5], which are settled focused needs in assembling technique writing.

Various contemplates have been accounted for in the writing on AMT [6],[7], [8], [9]. Every one of these examinations was in setting to developed nations. It appears that no investigation has been accounted for with regards to developing nation like India.

These Advanced Manufacturing Technologies are characterized as direct AMT, indirect AMT and administrative AMT. It should be referenced that this set is in no way, shape or form a thorough arrangement of exercises. Be that as it may, it catches the pith of progress exercises as rehearsed by Indian organizations. Hardware based innovations named as direct AMT. Programming based advances utilized for item plan and booking are named as indirect AMT, though, administrative AMT is utilized for reconciliation and simplification of production forms.

We[16] have classified Advanced Manufacturing Technologies into three parts:

1. Design AMT's
2. Administrative AMT's
3. Manufacturing AMT's

Design AMT's can be further classified into the following three technologies as shown below in table I:

**Table- I: Classification of Design AMT**

S. No.	Design AMT	Abbreviation
1.	Computer aided design	CAD
2.	Computer aided engineering	CAE
3.	Computer aided process planning	CAPP

**Table- II: Administrative AMT's can be further classified into the following eight technologies**

S.No.	Administrative AMT's	Abbreviation
1.	Enterprise resource planning	ERP
2.	Decision support system	DSS
3.	Electronic data interchange	EDI
4.	Material requirement planning	MRP
5.	Manufacturing resource planning	MRP II
6.	Activity based accounting systems	ABC
7.	Office automation	OA
8.	Just In Time	JIT

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**Table- III: Manufacturing AMT's can be further classified into the following thirteen technologies**

S.No.	Manufacturing AMT's	Abbreviation
1.	Computer aided Manufacturing	CAM
2.	Group technology	GT
3.	Flexible manufacturing system	FMS
4.	Numerical control	NC
5.	Direct Numerical control	DNC
6.	Computer Numerical control	CNC
7.	Computer integrated Manufacturing	CIM
8.	Automated guided vehicles	AGV
9.	Automated storage and retrieval system	ASRS
10.	Automated material handling systems	AMHS
11.	Automated Inspection systems	AIS
12.	Bar coding /Automatic Identification	BR/AI
13.	Robotics	RO

AMT assumes a significant job in quality and adaptability enhancements in assembling frameworks. The advantages of Advanced Manufacturing Technology have been generally announced in the writing and can be named tangible and intangible [7]. The tangible advantages, which are effectively quantifiable, include: stock investment funds, less floor area, improved Return on Equity and reduced unit cost of creation. The intangible advantage, which is hard to measure, include: an upgraded upper hand, expanded adaptability, improved item quality and snappy reaction to client request. The potential advantages, which can gather from interests in AMT, have gotten progressively obvious with developing worldwide challenge. AMT are activity designs in which an organization contributes to enhance its construction and foundation. Advanced Manufacturing Technology is regularly viewed as 'ready-to-wear' sets of basic and infrastructural problems. An organization chooses the Advanced Manufacturing Technology so as to fabricate the assembling abilities requisite by the market. AMT are utilized for activity the assembling technique. The appropriation of mechanized frameworks and cutting edge innovation has been one of the accessible options for organizations endeavouring to contend inside this new reality. Assessing capital speculations for the Installation of AMT is a basic assignment looked by assembling the board because of the high capital venture and the high level of vulnerability engaged with these ventures. The goal of this exploration is to

- 1 Evaluate the status of Advanced Manufacturing Technology in Indian assembling organizations of car, hardware, apparatus and procedure division.
- 2 Recognize AMT pertinent to manufacturing organizations
- 3 Measure the level of interest in AMT (direct AMT, indirect AMT and administrative AMT)
- 4 Recognize AMT execution steps

### Indian manufacturing industry

Manufacturing industry is comprised of various areas, every one of which is affected by the general manufacturing atmosphere, however every one of which likewise has its own high points and low points. From the Indian viewpoint, the significant assembling divisions are vehicle, hardware, apparatus and procedure ventures. These four parts are chosen for our survey [10].

### Automobile industry

The Automobile segment saw passage of worldwide players, for example, General Motors, Ford, Suzuki, Mercedes,

Honda, Daewoo, and so forth in the four wheeler section, and Piaggio, Honda, Suzuki, Kawasaki, Yamaha, and so on in the two wheeler section. The Indian Automobile sector has brilliant future as development rate in India is near about 8%. The development accompanied extending working class expanded acquiring intensity of Indian buyers, the expanding rivalry in vehicle industry and simple automobile financing. The vehicle business is genuinely full grown, includes enormous interests in innovative work and innovation and is viewed as a marker of the monetary advancement of the nation.

### Electronics industry

In Electronics industry, passage of worldwide organizations, for example, Samsung, LG, Sony, Aiwa, Nokia, Sansui, and so forth brought the challenge level up in the local Indian market. Household electronic machines are currently in the range of white collar class shopper because of aggressive costs and simple money related plans, which has expanded the interest for an assortment of apparatuses. An average white collar class purchaser wants to have his very own TV, clothes washer, music system and so on. The hardware business has developed as a development part.

### Machinery industry

In machine device industry, lead-time assumes a significant job. Presently, because of a simple import approach of the legislature of India, a client wouldn't like to sit tight for long time. Best quality machine apparatuses are accessible at focused costs in a short time from remote contenders. This circumstance has constrained the indigenous makers to give more consideration to this area. Indian hardware is a significant wellspring of contributions for the nation's resistance, railroads and infrastructure prerequisites too. As far as estimation of yield, the industry might be contributing close to 1% to the national Gross Domestic Product.

### Process industry

Process industry is the biggest division and incorporates organizations drawn from the manufacturing of concrete, petrochemicals, steel, manures, medicines and drug. India is fourth biggest maker of cement on planet after China, Germany and USA. The yield of concrete of different evaluations is around 200 million tons. Petrochemical business has been among the quickest developing areas. The utilization of petrochemicals including engineered filaments and intermediates records a development of 16%.

## II. LITERATURE REVIEW

The capacity to enhance effectively is a key corporate ability, depending emphatically on firms' entrance to information capital: exclusive, implicit and encapsulated. Here, we focus around one explicit wellspring of information propelled fabricating advancements or AMTs and think about its effect on firms' development achievement. AMTs identify with a progression of procedure developments which empower firms to exploit numerical and computerized advancements to streamline components of an assembling procedure.

Interruption impacts are apparent for the time being while positive development benefits happens nine plus years after selection.

Solid complementarities between at the same time received AMT propose the estimation of troublesome as opposed to gradual AMT execution methodologies.

The main objective is to exhibit basic factors that establish a fruitful execution of the AMT in Small and Medium scale Enterprise. The execution of AMT pursues a few procedures in particular pre establishment, establishment, and improvement. They directed a study to 125 SMEs which have executed AMTs, and found that the Critical Success Factor for each procedure is decently extraordinary. Great administration is the primary basic achievement factor for getting ready and establishment of the AMT. When the AMT began or introduced and landed at development organize, the monetary accessibility calculate turns a basic achievement factor in the AMT usage. In, develop arrange, the help and duty of top administration turns into a significant factor for increasing fruitful usage. By methods for factor examination, they could bring up that key factor is the fundamental factor in pre-establishment and establishment organize. At long last, in the development organize and develop arrange, both strategic and vital elements are the significant factors in the fruitful of AMT usage [11]

Their research rotates around the effect of AMT on industries. Insights instils that various industries, which are utilizing various types of AMTs. AMT is a nonexclusive term, portraying a get together of assembling innovations, which consolidates both degree and scale abilities in Manufacturing environment. [12]

The reason for their research is twofold: first, to investigate the connection between progress parameters and usage of advanced manufacturing technology (AMT); and second, to look at the progressions required in manufacturing system because of AMT execution. [13]

The advancements in the automobile part sector can be followed back with the liberalization at some stage in the 1990s. Before liberalization customer had restricted selection of variety and model to look over. Trade liberalization strategies brought about a convergence of international organizations in India. The section of these remote organizations changed quality guidelines and expanded the intricacy of the parts required by the OEM firms. Their research features the difficulties just as the constraints of the SME to move from the good old assembling procedures to the motorized assembling forms. The paper reasons that new automated assembling technique builds the quality and dependability and constrained the OEM firms to depend. [14].

Current manufacturing world is an excessively focused spot. To continue in this condition, manufacturing associations need more of viability, adaptability and advancement while producing their items. This can be accomplished by getting a handle on the advantages separated from the utilization of Advanced Manufacturing Technology (AMT). Choice and assessment of AMTs have been getting noteworthy consideration in the present manufacturing condition as this is by all accounts the main way out for economical improvement. Their research centres around the two practically unrevealed multi-criteria approaches to be specific inclination positioning association strategy for enrichment evaluations (PROMETHEE) and Dempster-Shafer Theory of evidence (DST) in view of the essential thought of technique for order preference by similarity to ideal solution (TOPSIS). It additionally depict a

comparative study of the two for solving an AMT choice issue in a given authoritative condition [15]

### III. RESEARCH METHODOLOGY

An organized questionnaire survey was created to qualify the assumptions; the questionnaire that is utilized in examination is joined with contributions from different source: the vast majority of the inquiries were adjusted from previously published research works and consequently, the questionnaire was talked about among the scholastic researchers and experts. The surveys were controlled through email, with a letter, to an aggregate of 740 industries, from which 242 industries replied with their information. After the arrangement and examination of the received information, analysis was done on the accompanying key point identified with the Manufacturing Industries and AMT.

- 1.) Manufacturing methodology of industries.
- 2.) Different kinds of AMTs
- 3.) Level of investment on Advanced Manufacturing Technologies
- 4.) Effect on performance after achievement of Advanced Manufacturing Technologies

#### Hypotheses Testing:

The value of cronbach's  $\alpha$  is 0.9226, it is recommended that opportunity of design AMT, administration AMT and manufacturing AMT are good in manufacturing industry.

**Null hypothesis ( $H_N$ ): All AMT is same for all sectors.**

**Alternative hypothesis ( $H_A$ ): All AMT is different for all sectors.**

As indicated by test null hypothesis is dismissed, it implies all AMTs are distinctive for various sectors. All the advanced planning technologies are emphatically connected and the value of cronbach's  $\alpha$  is 0.8929, which shows strongly dependable factors.

**Null hypothesis ( $H_N$ ): Every sector invests same in design technologies.**

**Alternative hypothesis ( $H_A$ ): Every sector invests different in design technologies.**

According to test null hypothesis is rejected, which bring to a close decision that the level of investment is not same for each sector.

**Null hypothesis ( $H_N$ ): Administration AMT is same for different sector.**

**Alternative hypothesis: ( $H_A$ ) Administration AMT is not same for different sector. From the test, the null hypothesis is rejected; it means administration AMT is not same for different sectors. Cronbach's  $\alpha$  is 0.8953; which means that all administration AMT are correlated.**

**Null hypothesis ( $H_N$ ): Level of investment of different sector is same.**

**Alternative hypothesis ( $H_A$ ): Level of investment is not same by different sector.**

From the test null hypothesis is discarded that signify the level of investment by different sectors is not same.

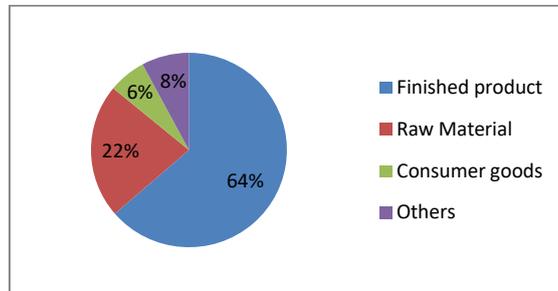
**Null hypothesis ( $H_N$ ): Efficiency improvement through AMT.**

**Alternative hypothesis (H<sub>A</sub>): Efficiency decline through AMT.**

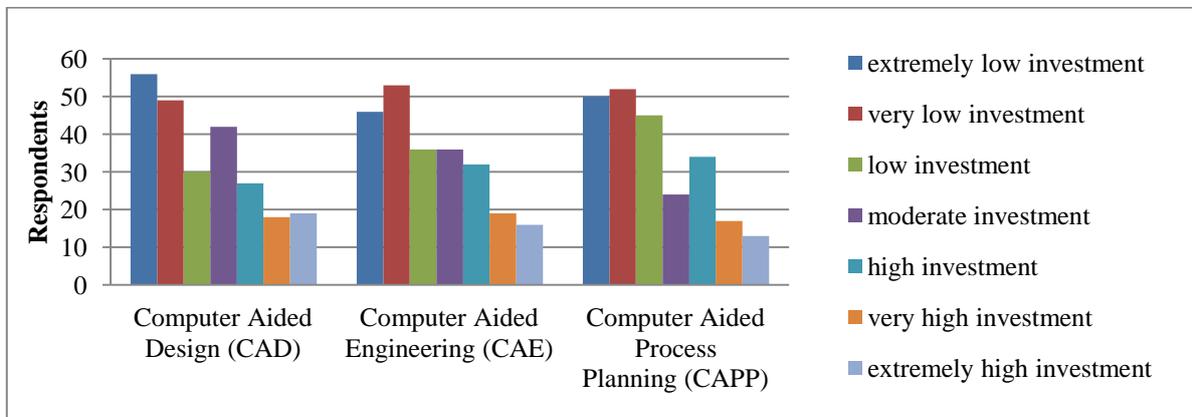
From the test null hypothesis is accepted, which shows that efficiency improvement of manufacturing industries through AMT.

As shown in figure 1, we find in our analysis that 64% industries are from finished products, 22% industries are from supplying the raw material, 6% industries are from the consumer goods industries and only 8% industries are from the industry sector which provides the services. The pie chart shows that most of the responses come from the finished product industry.

**IV. OBSERVATION**



**Fig. 1. Types of Product/Services Offered**



**Fig. 2. Degree of Investment in Design AMTs in Organization/Industry**

**Table –IV: Degree of Investment in Design AMTs in Organization/Industry**

S. no.	Design AMTs	extremely low investment	very low investment	low investment	moderate investment	high investment	very high investment	extremely high investment
1	Computer Aided Design (CAD)	56	49	30	42	27	18	19
2	Computer Aided Engineering (CAE)	46	53	36	36	32	19	16
3	Computer Aided Process Planning (CAPP)	50	52	45	24	34	17	13

Table IV shows that in case of CAD the highest response is ‘extremely low investment’ 56 respondents, which shows that most of the SME industries are investing less on CAD technology whereas in case of CAE the highest respondents are for ‘very low investment’ 53 and it is also ‘very low investment’ for the CAPP i.e. 52 and 13 is the least number

of respondents for ‘extremely high investment’ which shows that only a few industries are investing in design AMT.

**Table –V: Degree of Investment in the Administrative AMTs in the Organization/Industry**

S. No.	Administrative AMTs	extremely low investment	very low investment	low investment	moderate investment	high investment	very high investment	extremely high investment
1	Enterprise Resource Planning (ERP)	29	41	65	57	28	12	9
2	Decision support systems (DSS)	27	42	60	48	38	16	7
3	Electronic Data Interchange (EDI)	25	44	48	58	36	14	11
4	Material Requirement Planning (MRP)	7	49	46	63	37	23	15
5	Manufacturing Resource Planning (MRPII)	14	47	48	47	47	19	14
6	Activity Based Costing (ABC)	14	43	53	62	37	17	9
7	Office Automation (OA)	19	37	57	55	36	19	15
8	Just in Time (JIT)	13	38	44	52	46	30	18

The above table V shows that in case of administrative AMT 63 is the highest number of respondents for MRP

i.e. ‘moderate investment’ and the least the number of respondents is in case of MRP and DSS.

**Table- VI: Degree of Investment in the Manufacturing AMTs in Organization/Industry**

S.No.	Manufacturing AMTs	extremely low investment	very low investment	low investment	moderate investment	high investment	very high investment	extremely high investment
1	CAM	31	52	53	50	20	18	15
2	GT	14	40	60	62	37	16	7
3	FMS	16	41	78	47	28	16	11
4	NC	59	38	38	43	31	21	8
5	DNC	58	48	39	31	30	17	12
6	CNC	14	35	50	59	37	28	17
7	CIM	23	46	60	48	25	18	14

8	AGV	20	49	63	43	26	24	9
9	ASRS	24	44	62	47	34	15	9
10	AMHS	18	43	66	48	33	17	8
11	AIS	21	53	48	48	38	18	9
12	Bar Coding	22	49	49	51	31	24	9
13	Robotics	35	50	50	38	30	19	12

The table VI shows that in case of Manufacturing AMT the highest number of respondents is 66 i.e. for 'low investment' in automated material handling system (AMHS) and the least number of respondents is 7 in case of group technology (GT).

**V. RESULT AND DISCUSSION:**

From the above observation it has been concluded that advanced manufacturing technology which we divided into three parts i.e. Design AMT's, Administrative AMT's, Manufacturing AMT's have certain different effects on their implementation on various small and medium scale industries in Indian context. In case of Design AMT's CAD is the most important technology among all the technologies that we have considered. While in case of Administrative AMT's Material requirement planning (MRP) is considered the most important and in case of Manufacturing AMT's automated material handling system (AMHS) is considered important than the other AMT's.

**VI. CONCLUSION**

Computer aided design CAD, is the prevailing technology and Group Technology is the least prevailing technology for various manufacturing industries. . Process industries put modestly very less in AMT than electronics and automobile industries. Though almost all industries have decided to invest resources into AMT. All divisions share for all intents and purposes same point that interest in CAD takes the most noteworthy position sought after by the CAM and CAE, while GT merits the smallest to contribute. The electronics and automobile businesses have moderate enthusiasm for material dealing with framework. It is assumed that material handling with advancements (AGV, AS/RS, AMHS) gets minimal consideration in manufacturing enterprises. The most significant investment is made through CNC technology.

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**REFERENCES:**

1. S. Anderberg, T. Beno, and L. Pejryd, "Process planning for cnc machining of swedish subcontractors - A web survey," *Procedia CIRP*, vol. 17, pp. 732-737, 2014.
2. P. Levy, J. Bessant, C. Levy, S. Smith, and D. Tranfield, "Organizational strategy for CIM," *Comput. Integr. Manuf. Syst.*, vol. 4, no. 2, pp. 80-90, 1991.
3. M. Sacristán Díaz, J. A. D. Machuca, and M. J. Álvarez-Gil, "A view of developing patterns of investment in AMT through empirical taxonomies: New evidence," *J. Oper. Manag.*, vol. 21, no. 5, pp. 577-606, 2003.
4. N. B. Beaumont, R. M. Schroder, C. Campus, and C. East, "Technology , manufacturing performance and Susir s performance anlongst Australian man , jfactllrers," vol. 4972, no. 97, pp. 297-307, 1997.
5. R. D. R. Cardoso, E. Pinheiro De Lima, and S. E. Gouvea Da Costa, "Identifying organizational requirements for the implementation of Advanced Manufacturing Technologies (AMT)," *J. Manuf. Syst.*, vol. 31, no. 3, pp. 367-378, 2012.
6. M. H. Small and I. J. Chen, "Investment justification of advanced manufacturing technology: An empirical analysis," *J. Eng. Technol. Manag.*, vol. 12, no. 1-2, pp. 27-55, 1995.
7. F. T. S. Chan, M. H. Chan, and N. K. H. Tang, "Evaluation methodologies for technology selection," *J. Mater. Process. Technol.*, vol. 107, no. 1-3, pp. 330-337, 2000.
8. M. H. Small and M. M. Yasin, "Advanced manufacturing technology: Implementation policy and performance," *J. Oper. Manag.*, vol. 15, no. 4, pp. 349-370, 1997.
9. S. Kotha and P. M. Swamidass, "Strategy, advanced manufacturing technology and performance: empirical evidence from U.S. manufacturing firms," *J. Oper. Manag.*, vol. 18, no. 3, pp. 257-277, Apr. 2000.
10. G. S. Dangayach and S. G. Deshmukh, "Advanced manufacturing technology implementation: Evidence from Indian small and medium enterprises (SMEs)," *J. Manuf. Technol. Manag.*, vol. 16, no. 5, pp. 483-496, 2005.
11. J. Rahardjo and S. Yahya, "Advanced Manufacturing Technology Implementation Process in SME : Critical Success Factors," vol. 12, no. 2, 2010.
12. M. P. Singh and P. Y. S. Shishodia, "Study the Effect of Advanced Manufacturing Technologies on Manufacturing Industries," no. 4, pp. 48-53, 2013.
13. H. Singh and R. Kumar, Measuring the utilization index of advanced manufacturing technologies: A case study, vol. 46, no. 9. *IFAC*, 2013.
14. D. Bubber and A. Vashist, "IJREAS IJREAS ( ISSN 2249-3905 )," vol. 4, no. 2, pp. 80-92, 2014.
15. S. Nath and B. Sarkar, "Performance evaluation of advanced manufacturing technologies: A De novo approach," *Comput. Ind. Eng.*, vol. 110, pp. 364-378, 2017.
16. L. Taank and S. K. Jarial, "Advanced Manufacturing Technology : Implementation of Design AMT," no. 1, pp. 7633-7640, 2019.



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