Advanced Manufacturing Technology: Implementation of Design AMT

Lalit Taank, S.K. Jarial

Abstract: ***Technology plays a key role to create and maintain competitiveness in the universal arena. Technology is all the knowledge, processes, methods, tools, products and systems engaged in the design of goods or in providing services. Advanced Manufacturing Technology (AMT) is a new technology whose adoption changes the industry's manufacturing practice, production and approaches to design and management systems. Moreover, AMT plays a critical role in developing socio-economic environment and this brings further external effects to the country. Importance of technology for competitiveness is rising in emerging environment of AMT. The role of AMT had always been well understood in the developed nations, it is being touched by small scale and medium scale industries in developing country also. The importance of technology for business success and competitiveness has been confirmed empirically in several contexts.***

Keywords: Advanced Manufacturing Technology, Design AMT, CAD, CAE, CAPP

I. INTRODUCTION

According to present scenario Advanced Manufacturing Technology (AMT) may be described as gathering of manufacturing technologies, which includes both capabilities and scope in manufacturing surroundings. AMT is also defined by various researchers as an automatic production system, tools and machines for planning and managing of production system, this contains the procurement of parts and components, raw material, shipment of materials and finished product's service. AMT is basically evolved from the traditional manufacturing technologies and modern management and electronic information. Employment of AMT in industries can bring ample benefits and intangible strategic benefits due to its high flexibility and performance.

We 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:

i. Computer Aided Design (CAD)
ii. Computer Aided Engineering (CAE)
iii. Computer Aided Process Planning (CAPP)

Administrative AMT's can be further classified into the following eight technologies:

i. Enterprise Resource Planning (ERP)
ii. Decision Support System (DSS)
iii. Electronic Data Interchange (EDI)
iv. Material Requirement Planning (MRP)
v. Manufacturing Resource Planning (MRP II)
vi. Activity Based Accounting Systems (ABC)
vii. Office Automation (OA)
viii. Just In Time (JIT)

Manufacturing AMT's can be further classified into the following thirteen technologies:

i. Computer Aided Manufacturing (CAM)
ii. Group Technology (GT)
iii. Flexible Manufacturing System (FMS)
iv. Numerical Control (NC)
v. Direct Numerical Control (DNC)
vi. Computer Numerical Control (CNC)
vii. Computer Integrated Manufacturing (CIM)
viii. Automated Storage and Retrieval System (AS/RS)
ix. Automated Guided Vehicles (AGV)
x. Automated Material Handling Systems (AMHS)
xi. Automated Inspection Systems (AIS)
xii. Bar coding /Automatic Identification
xiii. Robotics (RO)

AMT shows a perfect relationship between manufacturing challenges and the technological potential. Advanced Manufacturing Technology also shows diversity in modern manufacturing system; primarily computer based which are dedicated to the upgrading of manufacturing processes. The implementation of AMT reduces the costs and improves the efficiency, so most of the companies are shifting on different types of advance manufacturing technologies. AMT's plays an important role in quality improvement in manufacturing industries. By the introduction of modern products with the high precision, changing needs and demands of customer, new manufacturing processes also helps the concept of AMT. AMT provides advantages in different areas that support the manufacturers to maintain quality. This way an individual unit like robot develops to further new integrated systems such as flexible manufacturing system (FMS) and finally to a fully integrated system called Computer Integrated Manufacturing (CIM). The level up to which a plant changes is dependent on the number of advanced manufacturing technologies implemented in addition to the level up to which investment is made. It has been found that flexibility of system generally reduces the cost, product development and ancillary system conversion.

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Implementation of design AMTs result in a decrease in total human resource costs and increases the value engineering of the product, as AMTs reduces the revenue rates by increasing employee satisfaction. Advanced manufacturing technologies have also minimized the amount of scrap and rework, which results in reliability and improved quality for the consumer.

The most important competitive weapons are not the technologies themselves, but its effective use, implementation, maintenance, and its management. Several organizational guidelines have been made to decrease vagueness in traditional manufacturing system. These guidelines can be eliminated with the use of advance technologies. The use of computer based network system and automatic machines provides competent information feedback system for physically longest manufacturing system also.

The AMT implementation affects not only the engineering design divisions of plant, but also the manufacturing divisions, marketing and human resource, research and development. With implementation of this technology the design of the organization as well as the relationship among different units also changes. The relationship involving the organization and its customers also change, i.e. organization can manage to changes in demand quickly and capable to offer improved quality, short lead time, and better reliability. For firms that have efficiently implemented AMT, the benefits have been excellent. General Electric implemented flexible manufacturing system in its locomotive plant and decreased machining hours for multi-ton engine frame parts from sixteen days to sixteen hours.

II. LITERATURE REVIEW

To explain the significance of design AMT to various manufacturing industries, we have cited literature focusing on the organizational factors important for the successful implementation of design AMT. It demonstrates the impact which design AMT can have in an organization or industry.

[1] Greening and Globalization are 2 most significant patterns of assembling. Each pattern has expanded store network and authoritative hazard and vulnerability. AMTs are assets that can help current industry in this intricate and unstable condition. Thusly, the determination and execution of greener AMT is basic for gathering all inclusive necessities. They introduced another strategy for expansive speculation of AMT. They expects to (1) develop viable green adaptability measure for assembling enterprises, consolidating diverse natural and monetary adaptability types, (2) for AMT assessment and positioning they present a cross breed plausibility different criteria choice model coordinating total prospect hypothesis and neighborhood harsh set hypothesis dependent on the three-parameter interim dark number, and (3) look at the reason for the proposed procedure in an unmistakable case to help fabricating specialist and analysts see how to inspect different AMTs in the choice condition. Various points of interest and disservices of the present philosophy are presented by them. They assessed the outcomes with the methodological, hypothetical, and the board suggestions that recognized. They set the base for impressive future research in green assembling in cutting edge fabricating innovation condition.

[2] Cardoso et. al. examined broadly AMT determination and selection forms. The intention of their examination is to recognize the elements that impact the AMT execution, accepting an assembling system setting and an examination dependent on configuration structure of an association. Their exploration technique depended on exact emphases by utilizing overview information, specialists' meetings data and a few contextual analyses. The outcome found by them demonstrates the suggestions that are emphatically impact the AMT execution. Associations need an organized methodology for the AMT usage for advantage of all the individual and widespread repayment. The AMT suggestions proposed for the reconciliation of these advancements to the association configuration are confined by auxiliary and relevant attributes.

Bourke et. al. [3] identify AMT with a grouping of procedure advancements which encourage firms to take help of numerical and computerized innovation to advance essentials of an assembling procedure. Utilizing gathered information, for Irish assembling associations they distinguished long learning by utilizing impacts as far as firms' capacity to create advancement favorable circumstances from AMT selection. Interruption impacts are clear for the time being while positive development favorable circumstances happen over six years after execution

As per NazliGoker and E. Ertugrul Karsak the Advanced assembling innovation has been broadly utilized on account of aggressive market powers and the snappy improvement in PC and designing regardless of the way that the assessment and choice require an entangled basic leadership process with countless choices and execution characteristics. They proposed an improved methodology for assembling innovation determination issue thinking about a few sources of info and yields. This methodology doesn't require a counter-intuitive separating parameter, pronounces to perceive the more effective FMS by the arrangement of a solitary blended whole number direct programming model, and displays better dispersal for information loads and yield loads [4]

Small and medium sized industries are adopting more advanced manufacturing technologies (AMT) aims to develop product innovation process, to improve quality of product, to reform the production process, and to increase productivity. In their investigation, they break down capability of connection between AMT levels in assembling enterprises and item development execution. Utilizing information from 616 assembling little and medium estimated ventures, and by considering an expansive scope of AMT (twenty unique kinds of AMTs gathered into five distinct classes), they created three AMT adjustment designs through a group investigation strategy blending progressive and non-various leveled bunching calculations.

The exploration of the relationship among AMT mix examples and development of item execution represent a surprising picture, regardless of the presence of particular examples of AMT, they locate no noteworthy relationship among example and item advancement execution. In its place, they see the authoritative setting of SMEs as a greater number of determinants for item development execution than any of the AMT mix designs. For all intents and purposes their investigation shows that assembling SMEs directors focus on cultivate their advancement capacities through AMT reconciliation should be mindful in the end impacts of associations age, size, and zone of movement. [5]

Their examination clarifies the cost decrease with the assistance of change in procedures of little scale enterprises. They additionally centered on the progression up that can give the base dismissal level items. In their examination information were gathered by testing extraordinarily in the wire tackle manufacturing industry for car vehicles. By actualizing the proposed alterations in enterprises the nature of the items can be improved. With the adaption of Kaizen systems the procedures was made increasingly proficient and progressively powerful [6].

AMT improves the business efficiency just as it influences the social viewpoints, for example, macroeconomic, work, and the steady advancement. Organization should take reasonable choice thinking about much from sociological perspective, on the grounds that the general public advantages are a lot of significant than the benefits toward the business. They make the social assessment system to the AMT and apply fluffy assessment to measure the assessed outcome. They accept a venture from China for instance to test this strategy and check the undertaking's plausibility[7].

With the significance on expanding proficiency and decreasing costs, most extreme organizations are leaving on different types of development fabricating innovations (AMT). AMT is to a great extent characterized by numerous scientists [8], [9] as a programmed creation arrangement of individuals, machines and apparatuses for the improvement and control of the generation procedure, together with the acquisition of crude materials, segments and parts, conveyance and administration of completed items. Fundamentally AMT is characterized as any most recent assembling strategy, the execution of which is probably going to prompt change the association's assembling practice, the executives frameworks and configuration approach and the creation designing of the item [6].

Propelled fabricating innovations should be a significant component by organizations in surpassing aggressiveness. To accomplish wanted outcomes, the structure and framework of associations must match to verify that the usage of advancements lead to the evaluated advantages. They build up a system that represents set of recommendations proposing that organization execution will be expanded by adjusting the authoritative structure, culture and assembling technique with suitable practices to improve human asset capacity and aptitudes in innovation usage. The structure can be abridged into a T O P guide to demonstrate the arrangement of innovation, association, and execution in innovation selection[10].

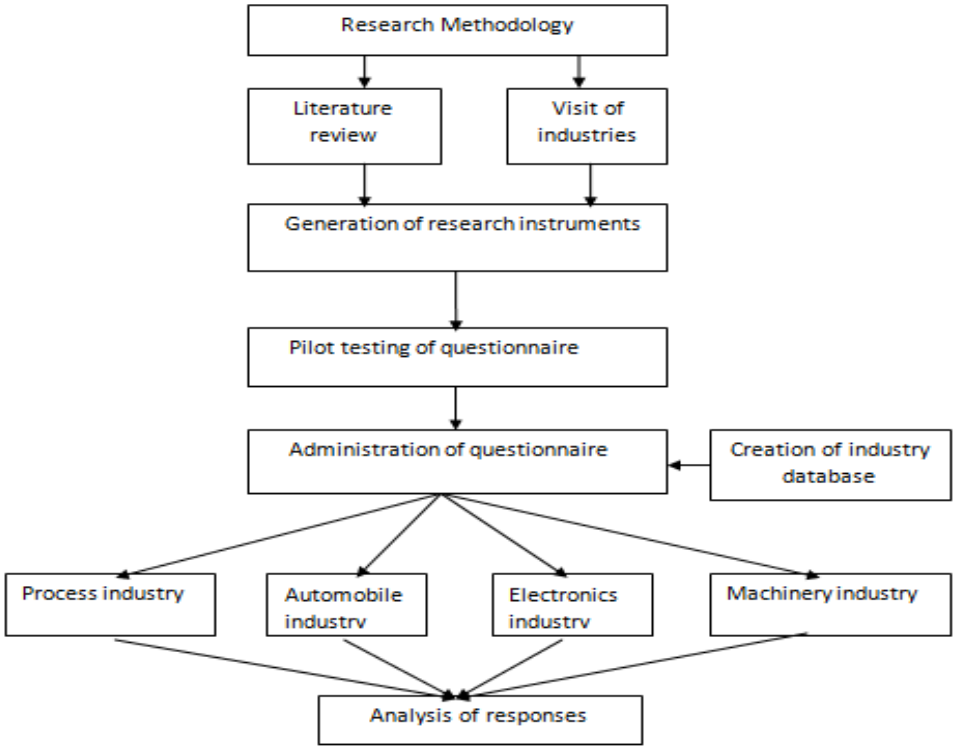
Their examination explores the mind boggling connections among cutting edge producing innovation AMT, system and execution by overview reactions from 160 U.S. fabricating associations. In contrast with past examinations that put accentuation on adaptability measurement of AMT, their investigation executes a multidimensional perspective on AMT by focusing on the data handling capacity inbuilt in AMTs. They discovered help for four components of AMT: data trade and arranging innovation, item structure innovation, low-volume adaptable robotization innovation, and high-volume computerization innovation. They likewise show support for the examination's significant reason that a fit among distinct techniques AMT measurements will be connected with better outcomes. With the utilization of discoveries, their examination proposes a few roads for future examination. [11]

Endurance depends primarily on intensity. Intensity lands with an incorporated exertion through various capacities and activity of cutting edge producing advances. AMT assumes a significant job in quality enhancements in assembling associations. The origination of innovation as a focused weapon is picking up energy due to the brisk presentation of most recent items with the high intricacy and precision, changing in client needs and desires, new assembling procedure, including differing degrees of item support. AMT gives benefits in field that would enable producers to look after quality, authoritative, operational and money related exhibitions to create mechanical intensity. Their exploration reports discoveries of a functional investigation of procedure industry with the assistance of poll overview[12]. The methodology created by them is fundamental due to the integral idea of AMT with such a large number of offices in the association. The more incorporated the framework, the more basic the requirement for contribution from numerous offices during the arranging stages. A subsequent factor to decide the fruitful execution of AMT is guarantee from both a task champion and from the establishment overall. It is discovered that without strong devotion from the administration and laborers the maximum capacity of AMT can't be accomplished. The confidence of the association in AMT influences numerous kinds of advantages got from the usage, for example, return on quality, level whenever upgraded aggressiveness, measure of cost decreases works conditions and improvement in charge (Udo and Ehie, 1996). Adaptability diminishes the building cost of configuration changes and the chaperon framework alterations. Then again, these reserve funds are balanced by expanded expense for programming the hardware. The work changes are likewise counterbalanced, as there is abatement in untalented work necessity yet an expansion in talented work (Sanchez, 1996). The expansion in worker strengthening needs a corresponding change in employing and preparing arrangements just as an adjustment in the impetus structure of the association. With expanded duty, laborers will anticipate expanded pay rates and different impetuses. All the human asset arrangements must be set to concur with the progressions to the new desires put on the laborers[13].

Frohlich found that expanded coordination of worker's endeavors utilizing non-specialized methods (e.g, encouraging correspondence) was connected to build execution and development with AMT. This expansion in correspondence encourages the required collaboration between various gatherings of the association to help take care of issues all the more effectively. The incorporation of the frameworks is basic so that the total association can accomplish the most elevated profit by AMT [14].

III. RESEARCH METHODOLOGY

In this section we will discuss the methodology to obtain the results that are needed to validate the research carried out by us. The research methodology we use to carry out our research work is based on questionnaire survey. A questionnaire was sent to different small and medium scale industries to collect the responses. Based on the responses collected from various organizations the collected data was analyzed using SPSS software.



IV. OBSERVATIONS

In our study we classified the advanced manufacturing technology in three parts i.e.

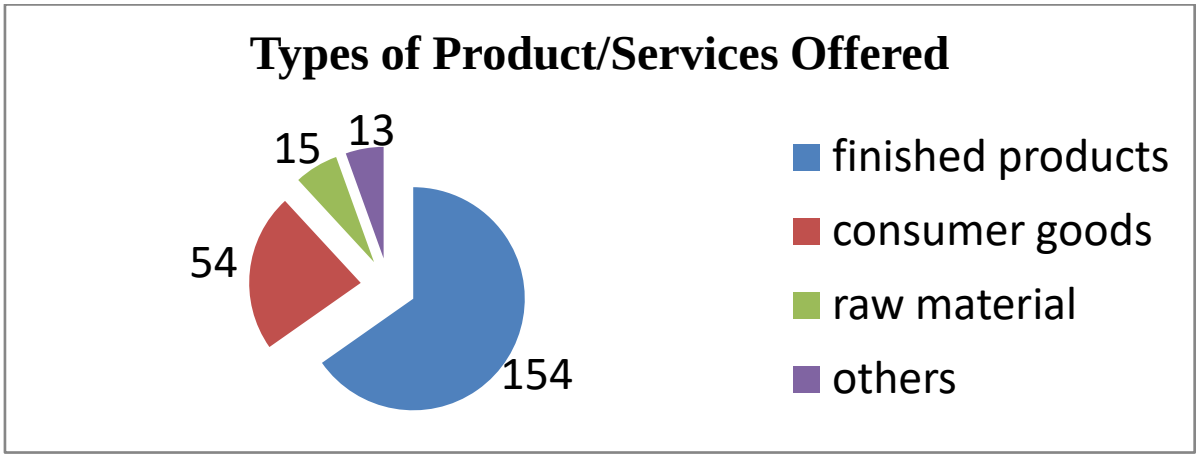
i) Design AMT
ii) Manufacturing AMT
iii) Administrative AMT

different organizations.

Here we will discuss the observations based on the data collected from 242 industries by using questionnaire survey. As we have discussed in the introduction section that design AMT can be further classified in the below three parts

i. Computer aided design (CAD)
ii. Computer aided engineering (CAE)
iii. Computer aided process planning (CAPP)

Figure 1 shows the types of products/ service offered by



(Fig. 1)

As shown in the above figure 154 out of 242 industries are manufacturing the finished goods. While 54 are manufacturing the consumer goods and 15 are processing the raw material. So by the observation it is seen that a huge number of industries are involved in manufacturing of finished products.

Table- I: Various types of customers

Sr. no.	Customer	Number of Respondents
1.	consumer	53
2.	Service industry	30
3.	Manufacturing industry	151
4.	Government sector	7
5.	Food processing industry	1

The above table shows that the list of various respondents among which 53 are the consumers. 151 are from manufacturing industry, 30 respondents are from service industry, 7 respondents are from government sector and one response is from food processing industry.

On the basis of collected data from different respondents we will discuss only one type of advanced manufacturing technology i.e. design AMTs. In case of design AMTs we have classified it in 3 categories i.e. computer aided design, computer aided engineering, and computer aided process planning. The questionnaire sent to different industries was designed on seven point fuzzy scale.

Table- II: Different types of Industries

Industry sector	Questionnaire sent	Number of Respondents (%)
Automobile	160	60 (37.50%)
Electronics	160	71 (44.37%)
Process	160	62 (38.75%)
Machinery	160	48 (30.00%)
Total	640	241

In case of CAD out of two hundred forty two respondents fifty six respondents shows that extremely low investment is done in industries while nineteen respondents shows that extremely high investment is done in industries on CAD technology and forty two respondents shows that moderate investment is done on CAD technology.

Table- III: Responses in case of CAD

S.No.	Computer Aided Design (CAD) Fuzzy scale	Respondents
1.	extremely low investment	56
2.	very low investment	49
3.	low investment	30
4.	moderate investment	42
5.	high investment	28
6.	very high investment	18
7.	extremely high investment	19

In case of Computer Aided Engineering (CAE) fifty three respondents out of two hundred forty two respondents is having very low investment while only sixteen respondents is having extremely high investment in computer aided engineering and forty six respondents is having very low investment which is second most high response from the respondents shows that in small and medium scale industries CAE is also not implemented on big scale, only a few industries like to invest on CAE.

Table- IV: Response in case of CAE

S.No.	Computer Aided Engineering (CAE) Fuzzy scale	Respondents
1.	extremely low investment	46
2.	very low investment	53
3.	low investment	36
4.	moderate investment	40
5.	high investment	32
6.	very high investment	19
7.	extremely high investment	16

In case of Computer Aided Process Planning (CAPP) out of two hundred forty two respondents fifty two respondents is having very low investment and fifty respondents is having extremely low investment. Only seventeen out of two hundred forty two respondents are having very high investment in CAPP.

Table-V: Responses in case of CAPP

S.No.	Computer Aided Process Planning (CAPP) Fuzzy scale	Respondents
1.	extremely low investment	50
2.	very low investment	52
3.	low investment	45
4.	moderate investment	24
5.	high investment	34
6.	very high investment	17
7.	extremely high investment	20

The below table shows that in case of CAD there is highest response for extremely low investment and the lowest response is from CAPP i.e. 17 for very high investment which shows that small and medium scale industries do not take interest in design AMTs as a high investment is needed and small and medium scale industries do not have enough budget for investment in design AMTs but some industries take part in the investment for advanced manufacturing technologies to improve the performance of the industry.

Table VI shows that with the advancement in the technology small and medium scale industries also started making investment in design AMTs i.e. CAD, CAE, and CAPP. The table also shows that CAD is having more investment than the CAE and CAPP. After CAD, CAPP is having more investment than CAE. From the below three shown in the table VI CAE is having very less investment.

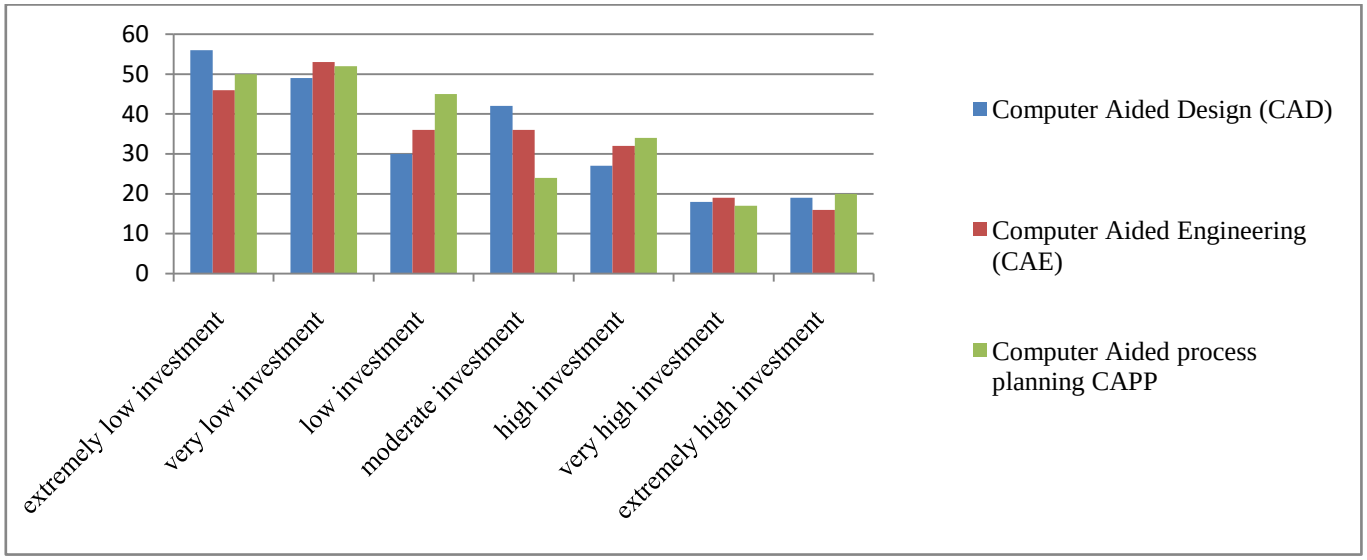
Table-VI: Overall comparison of CAD, CAE, CAPP

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	28	18	19
2	Computer Aided Engineering (CAE)	46	53	36	40	32	19	16
3	Computer Aided Process Planning (CAPP)	50	52	45	24	34	17	20

ADOPTION OF DESIGN ADVANCED MANUFACTURING TECHNOLOGY

The selection of Design AMT enables businesses to separate from the conventional assembling procedures of making progress toward minimal effort initiative and separation. Effective selection of AMT empowers enterprises to accomplish economies of scale and extension all the while. That is, actualizing Design AMT diminishes the expense of future item development, enabling the ventures to build its speed of reaction to market and aggressive changes. In this way, interest in Design AMT speaks to a key alternative, the estimation of which increments in a situation of aggressive and market vulnerabilities. Respondents were approached to rate the business proficiency in term of profitability, plant productivity, item the board and market execution on a 1to7 point level scale, where 1 show extremely low investment, 4 demonstrate moderate investment and 7 show extremely high investment.

It is seen from the figure 2 that productivity improvement of manufacturing industries through AMTs. As far as AMTs venture, by and large overviewed businesses put moderate in AMTs, The most put advances are in structure and building innovation, trailed by machines and arranging advances. Ventures put least in material taking care of advances.



(Fig. 2)

V. RESULT AND DISCUSSION

From the above data obtained by questionnaire survey through email, we can conclude that CAD is having less investment as compare to CAE and CAPP whereas the CAPP technology is having high investment in all three technologies considered in our research

VI. CONCLUSION

Effective implementation and execution of design AMT process starts from the phase of pre establishment, establishment, improvement and development. At each phase of the usage process there are a few basic factors that must be considered so as to prevail in the usage process. In the pre establishment and establishment stages, the vital factor is the basic factor to be thought about where the Good Leadership and backing from top Management will decide the fruitful execution of design AMT. In the improvement stage it is to be noted that strategic components are significant factor too, particularly on budget accessibility factor. Accessibility of fund is required for the procedure of design AMT improvement. Apart from this factor, the foundation of corporate culture is a significant factor in the development which accentuate on the nonstop improvement as a corporate culture. Another factor that increases effective execution of design AMT is the accessibility of specialists and furthermore control over the handling. The achievement of the past stages will significantly influence. During the implementation both strategic and key factors should have been considered in making the progress of design AMT. Support from top administration is very important in the implementation and running of design AMT.

LIMITATIONS AND SCOPE FOR FUTURE WORK

The four major sectors (process, machinery, automobile and electronics) have been included in our study. Industries from all regions of the country responded to the questionnaire. The response rate is 37.6%, which is higher than as suggested by Flynn et
al. (1990) (between 10% and 30%) for such type of studies. However, this study has some limitations, which future researchers could consider. Other sectors can be included in the study and/or the present sectors can be further classified (e.g. further classification of automobile into two categories, i.e. component and vehicle manufacturers).

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