

CAD/CAM SOFTWARE SELECTION FOR SMALL AND MEDIUM SCALE MANUFACTURING ORGANIZATIONS IN KOLKATA

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ABSTRACT

In India there are two completely different manufacturing environments in East and West. Western industries are more liberal in their outlook in terms of development, introduction of new technology etc whereas Eastern Industries especially in Kolkata possess a more socialist framework. CAD/CAM techniques are nothing new to Indian market. But small and medium scale manufacturing organizations in Kolkata lacks the knowledge and ability to select and use an adept CAD/CAM environment from which they will benefit. In this paper we tried to demonstrate the current condition of CAD/CAM system selection in small and medium scale industries of Kolkata by performing surveys in a few organizations. We tried to study and improve the technique of selecting their CAD/CAM environment. We start with a survey of their current status of CAD/CAM system usage. We developed a basic questionnaire for this purpose. We analyze their needs and came up with tailor-made solutions.

Keywords—Computer aided design, Computer aided manufacturing, Need prioritization, System selection.

INTRODUCTION

Computer-aided design (CAD) and manufacturing systems have a history in assisting companies in design and high-speed manufacturing. Complex parts can be designed quicker with softwares that enable the user to visually see the part and its dimensions. These software programs can provide the compatibility to assemble parts together, checking for fit while also providing the capability to edit the part at any time. This allows complex designs to be made quicker, and more accurately. Computer-aided manufacturing (CAM) packages allow these complex parts to be brought to life by calculating tool paths and writing the code to manufacture the part on a computer numerical controlled (CNC) machine such as a milling machine or lathe. Human error is reduced and higher accuracy can be attained when manufacturing parts that would be difficult to produce manually. Globally and locally there are companies using obsolete packages to design and manufacture products. Since technology is changing very rapidly and most companies cannot update with the technological advancements. The need to know what CAD/CAM packages are available and how to select one will help companies build for the future. In this paper an approach is made to find the best or suitable packages among the available software packages for a few small and medium scale manufacturing firms.

The manufacturing philosophy in small and medium scale organizations is very different from large scale manufacturers. There are several CAD/CAM packages available in the Global market today. But the acceptability of this software in these markets especially in Eastern India is very limited. People think that

their production or product will not vary if CAD/CAM software is used. Some people see an expense on CAD/CAM software as illegitimate and un-called for and still prefers conventional hand drawings. This is why there is a huge potential of introducing feature based software in these areas. Hence, Eastern India is a potential market for Introduction of this kind of software and diversifying on it.

ORGANIZATION SELECTION AND SURVEY

A careful selection of manufacturing organizations is done which range from small to medium size organization. In our survey we have considered organization which operates in Kolkata region and have an annual turnover less than ₹ 1 million. Four organizations are selected which covers different part of the design and manufacturing industry. We have selected companies doing metal fabrication work (M/s Betterman Engineering Pvt Ltd), auto component and diesel engine component manufacturer (M/s Simpson and Company Ltd), manufacturer of power plant components such as boiler tubes and Electrostatic precipitator (M/s DesFab India Pvt Ltd) and an educational organization which provides CAD/CAM software knowledge to young professionals and students (CADD Center, Kolkata). A survey was conducted at their premise which is given in a tabular format. The table of questionnaire is prepared carefully after consulting with the management of the organization and a few experts working in computer aided design and manufacturing. The questionnaire prepared is very standard and is kept simple for the sake of better understanding and interpretation. The organization's participation in answering questions in this survey will help identify information on important criteria for a CAD/CAM system selection. The responses will be kept confidential and used solely for the purpose of this study (Mercer 2000).

A. Survey at M/s Betterman Engineering Pvt Ltd

They are basically fabricators and metal workers. They work on contract basis for big MNCs who provide them their own drawings. They also accept projects from smaller clients for bought-out items. They use AutoCAD 2011 64 bit licensed version. Table I at the end (Appendix) depicts the survey.

B. Survey at Simpsons and Company Ltd

They are Auto component and Diesel Gen-set manufacturers. They also manufacture diesel engine parts. They use CNCs extensively. They are tier 2 suppliers of Hindustan Motors. A well structured organization with heavily equipped R&D department was developed in 1840. Table II (Appendix) depicts the survey.

C. Survey at DesFAB Engineering Pvt. Ltd

They are Boiler and ESP component manufacturers. Drawings are produced by consultants who use CAD/CAM systems and sometimes the drawings are created by employees for better understanding in the shop floor. They are using AutoCAD 2013 (non licensed version). Main work includes preparation of assembly drawings and part drawings for welding and fit up. Though rarely used, for 3D assembly drawings they are using Autodesk Inventor Professional. Table III (Appendix) depicts the survey.

D. Survey at CADD Center, Kolkata

They provide training and placement services for young professionals and students who seek to make their careers in CAD/CAM in industries. This organization was selected to find out what sort of

CAD/CAM software courses they offer and which software have greater demand amongst the job seekers in this field. It was noticed that CAM software demand was very less. The only course is NX CAM which CADD Center Kolkata is providing. This has a direct relation with the manufacturing market of Kolkata (overall West Bengal). Table IV (Appendix) depicts the survey.

CAD/CAM SOFTWARE SELECTION

Standard guidelines of selecting business softwares are followed. All the above organizations are advised to upgrade their software usage depending on the business software selection model:

1. Need: To reduce uncertainties at the shop floor, to remove delays in shop floor, better employee governance, and cost management at various levels are most important.
2. Priority: Fig. 1 shows the ranked priority sheet which was prepared by taking the suggestion of the organization's management, advisors and a few employees. The priorities are ranked. This shows how the software should be selected so that top priorities are met.

Priorities	Rank
Reduce design time	4
Reduce manufacturing time	7
Streamline design activities	6
Reduce uncertainties in the shop floor	1
Timely disposition of design	13
Proper software usage	18
Hiring of well trained employee	19
Reporting of error	14
Troubleshooting	15
Minimizing of Troubleshooting time	16
Training employees	11
Better employee governance	12
Outsourcing design	8
Faster goods delivery	5
Reducing m/c down time	10
Reduction of bottlenecks	9
Integration with FANUC system of working	17
Low customer complains	2
Easy auditing process	20
Cost management at various levels	3

Fig. 1 Prioritizing the needs by Ranking

3. Vendor credibility and longevity: Well known vendors of Creo 2.0 and Autodesk Inventor are identified using "ptc" and "Autodesk's" dealer locator.
4. Software Reliability: A comparison is done for Creo2.0 and Autodesk Inventor 2014 which is shown in Fig 2.

Software: Creo 2.0	
Questions	Answers
How often is the software unavailable or offline due to technical issues	Never
On avg how quickly the technical issue is resolved	48 hours post contacting the IT Help
who is the vendor	Chabaria Infotech, Kolkata
upgradation possibility	Yes
Cost	
Additional features	
Software: Autodesk Inventor 2014	
How often is the software unavailable or offline due to technical issues	Never
On avg how quickly the technical issue is resolved	
who is the vendor	Chabaria Infotech, Kolkata
upgradation possibility	Yes
Cost	Commercial software pack Rs 1,60,000
Additional features	Complete pack with CAD Mechanical, AutoPipe and Inventor 3D

Fig 2. Software Reliability of Creo 2.0 and Inventor 2014

5. Operation Integration: Possibility of combining few operations by using Autodesk Inventor is noted:

- Better visualization of design hence quick Purchase order generation start at M/s DesFAB
- Better Inventory control at Simpsons & Co.
- Better and faster documentation of Design at M/s DesFAB
- Quick removal of previous revision drawing from shop floor at M/s Betterman.

6. Pricing: This is a tricky part. There are few students version of the software the companies are using free of cost. Due to the non commercial nature many software are incapable of handling the advanced features of the commercial packages. As the investment per licensed version is high some resistance was felt in this section.

Creo 2.0 sketch (with 3D extension) = Rs. 2, 25, 000/- (TRISITA Marketing Ltd, Kolkata)

Autodesk CAD (Mechanical) = Rs. 1, 60, 000/-

(Autodesk reseller Chabaria Infotech Ltd, Kolkata)

Autodesk CAD (Premium) = Rs. 2, 50, 000/-

(Autodesk reseller Chabaria Infotech Ltd, Kolkata)

7. Making sure on ROI: New integrated software tools that are commercially available have been developed which allow design engineers to perform finite element analysis directly, during the early stages of design, thereby ensuring that the best design intent is achieved. (McGuffie, 1999) This in turn reduces final prototype numbers, lowers design costs, and decreases time to market.

8. Training: A lot of training material are available online and can be accessed by the employees. CADD center's strategic training partnership program will improve software literacy (to be started from June, 2014).

RESULTS AND RECOMMENDATIONS

Survey results indicate that most organizations use old and outdated systems. A modified CAD/CAM software selection is done on the basis of their work volume and need. A system requirement chart is prepared which helps the organizations to select the hardware. The system requirements are given in Table V. We have tried to integrate the system requirement and the need. A computer program has been developed to simplify the selection process. Borland Turbo C++ is used to write the code. The simple program follows an unambiguous logic accepting the TAG numbers given to the system requirements. The requirements and needs are tagged for the convenience of program writing. The logic is the system requirements are classified in Tags. If all the Tags of the hardware requirements and system requirement of software match, that software is selected. If the concern is already using that software, no change is suggested. If the concern is not using that software an update is recommended. The codes written and output obtained is attached as appendix to this paper in Appendix at the end. The Tags are showed in Fig 5 at the end.

Following the program, we have provided a selection process of CAD/CAM system based on system requirements, need of the organization and personnel expertise available. Fig. 3 shows the selection for M/s DesFAB.

Name	Current software	Major Problem	Proposed Software	System used	No of Designers	Reason
M/s DesFAB	AutoCAD 2013, Autodesk Inventor	Problem with Editing and Printing	Autodesk Inventor 2014	4x64bit Windows 7, 500GB, 4GB RAM	4	1) Min RAM 3GB 2) Faster troubleshooting 3) Both 32 Bit and 64 bit application

Fig. 3 CAD/CAM software selection for M/s DesFAB

M/s Betterman was having problems with speed of the system and importing 3D models in their ProE version 4.0. An alternative is provided based on the above mentioned categories. Fig 4 shows the selection for M/s Betterman.

Name	Current software	Major Problem	Proposed Software	System used	No of Designers	Reason
M/s Betterman	AutoCAD 2011, ProE wildfire version 4.0	Problem with speed and importing 3D model	Creo 2.0	4x64bit Windows 7, 500GB, 4GB RAM	3	1) Min RAM 3GB 3) 32 Bit system

Fig. 4 CAD/CAM software selection for M/s Betterman

M/s Simpson and Co. is using Creo 2.0 for 3D modeling and AutoCAD 2014 for production drawing purpose. When the C program is run it indicated Creo 2.0. They are already using Creo 2.0 so no change is recommended. Hence it forms a benchmark which the others will try to reach. At some point of time someone at Simpson must have understood the need of up-gradation. But now they can have a method of analyzing and upgrading their systems.

Training plays a critical role in the overall CAD/CAM system development. In Kolkata there are very less opportunity to understand and learn CAD/CAM software that is prevalent in the market. Most of the employees land up learning the software by themselves. But in this process they tend to miss out important features of the software which play very important roles in a commercial package. Hence the software remains underutilized. That is why we have considered CADD Center, Kolkata in this survey. A strategic tie up between them and the industry can bolster the understanding and utilization of these softwares.

After the selection of the system is done, satisfaction is to be analyzed. Further studies may be undertaken to find out whether a substantial development has occurred. If not, we find out what was the fault in the earlier selection system.

CONCLUSION

While preparing and selecting a CAD/CAM system many factors are to be considered. Need analysis and prioritization should be given foremost importance along with the various software and hardware requirements. The software selected now will not last for a long time as technology advancement is taking place at a rapid rate. Though small and medium scale industries have limitation on spending, a routine upgradation of the system is necessary. Training and communication also play a very important role in an accurate system selection.

CAM systems are rarely used in Kolkata. If sophisticated machining is required people prefer western Indian manufacturers. Kolkata has got huge potential in manufacturing. With rapidly developing states like Orissa and Jharkhand nearby the manufacturing demand has increased. Many industries are using CAD/CAM system but are unable to exploit the softwares fully. Our target is to solve this problem by improving the communication between the software providers and manufacturers. With the written consent of the organizations we plan to share the survey data with leading design and manufacturing software providers in the country who will provide technical as well as learning guidelines for them.

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APPENDIX

The computer program:

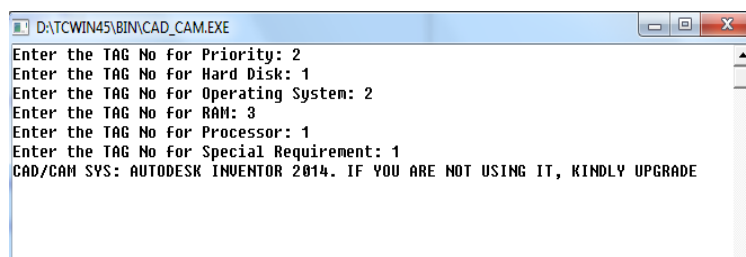
```
#include<stdio.h>
#include<conio.h>
void main()
{
int pr, hd, os, ram, pro, sp_req;
clrscr();
printf("Enter the TAG No for Priority: ");
scanf("%d", &pr);
printf("Enter the TAG No for Hard Disk: ");
scanf("%d", &hd);
printf("Enter the TAG No for Operating System: ");
scanf("%d", &os);
printf("Enter the TAG No for RAM: ");
scanf("%d", &ram);
printf("Enter the TAG No for Processor: ");
scanf("%d", &pro);
printf("Enter the TAG No for Special Requirement: ");
scanf("%d", &sp_req);
if (pr<4)
{ if (hd<3)
{ if (os<=3)
{ if (ram<5)
{ if (pro<3)
{ if (sp_req<=3)
printf("CAD/CAM SYS: AUTODESK INVENTOR 2014. IF YOU ARE NOT USING IT,
KINDLY UPGRADE");
} else
printf("CAD/CAM SYS: AUTODESK INVENTOR 2014. IF YOU ARE NOT USING IT,
KINDLY UPGRADE");
}
else
printf("CAD/CAM SYS: CREO 2.0 IF YOU ARE NOT USING IT, KINDLY UPGRADE");
} else
printf("CAD/CAM SYS: CREO 2.0 IF YOU ARE NOT USING IT, KINDLY UPGRADE");
}
```

```

    } else
    printf("CAD/CAM SYS: NX CAD IF YOU ARE NOT USING IT, KINDLY UPGRADE");
} else
{
printf("TRY NEW SELECTION");
}
getch();
}

```

Output:



Hard Disk (GB)	Tag No	Processor	Tag No	RAM (GB)	Tag No
150	1	Intel Xeon E5	1	1 GB DDR2 SATA	1
200	2	AMD A 10	2	1 GB DDR3 SATA	2
250	3	AMD FX	3	1 GB DDR2 PATA	3
500	4	Intel i3 3470	4	2 GB DDR3 SATA	4
1024	5	Intel i5 3570	5	2 GB DDR2 SATA	5
5120	6	Intel i7 3970x	6	3GB DDR2	6
				3GB DDR3	7
				4GB	8
				6G SSD	9

Operating Sys	Tag No	Sp Req	Tag No
Windows XP	1	DVD Drive	1
Windows 7	2	Broadband	2
Windows 8	3	Open GL 3.1	3
		Video Card	4

Fig: 5 Tag No of Hardware systems

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Questionnaire for CAE Tool Support in Eastern India-Kolkata		
Name of Organization: Bettermann Engineering Pvt Ltd, Howrah, West Bengal		
Type of Organization: Manufacturing/Fabrication		
Establishment year: 1984		
Field of work: Metal Fabrication		
Date of survey: 17/01/2014		
Sr No	Quarries	Response
1	Do you support CAE tool application	No
2	What CAE software tool do you use	AutoCAD 2011, ProE
3	Are they Licenced versions	Yes
4	In what frequency do you upgrade those tools [1: 6m, 2: 1Yr, 3: 1.5 Yr, 4: 2 Yr, 5: 2+ yrs]	5
5	Are you open to using trial versions of a different CAD tool	Yes but not in production as of now
6	Are you open to using trial versions of a different CAM tool	No
7	Do you use a 3D modeling software	Yes
8	Do you create a production drawing from client's drawing	Yes
9	Which features do you use	Geometries, Pad, hole, chamfer, fillet etc. Not highly graphical features such as material selection etc
10	Frequency of using those features [from 1 to 5. 1 being least frequent and 5 being very frequent]	3
11	Do you use advanced graphics in your design	No
12	Do you have/use material selection option in your drawing	No
13	Do you use advanced features like splines/Bsplines in your design	Yes
14	How often do you communicate with the Software provider services [from 1 to 5. 1 being least frequent and 5 being very frequent]	1
15	What sort of difficulties you face with your existing CAE Package	Slow, Problem in importing 3D model
16	How much are you ready to invest on a New, Improved CAE Package [1: less than 20k, 2: 20-50k, 3: 50-100k, 4: 100-200k, 5: 200k+]	1
17	Do you subcontract drawings	Yes
18	Would you like to share this data with CAE tool providers in Kolkata	Yes

Table I. Survey report of M/s Betterman

Questionnaire for CAE Tool Support in Eastern India-Kolkata		
Name of Organization: Simpsons and Company Jessore Road, Kolkata		
Type of Organization: Manufacturing/Service		
Establishment year: 1840		
Field of work: Manufacturing		
Date of survey: 22/01/2014		
Sr No	Quarries	Response
1	Do you support CAE tool application	Yes
2	What CAE software tool do you use	AutoCAD 2013, 2014, ProE, Creo 2.0
3	Are they Licenced versions	Yes
4	In what frequency do you upgrade those tools [1: 6m, 2: 1Yr, 3: 1.5 Yr, 4: 2 Yr, 5: 2+ yrs]	5
5	Are you open to using trial versions of a different CAD tool	Yes but not in production as of now
6	Are you open to using trial versions of a different CAM tool	No
7	Do you use a 3D modeling software	Yes
8	Do you create a production drawing from client's drawing	No
9	Which features do you use	All
10	Frequency of using those features [from 1 to 5. 1 being least frequent and 5 being very frequent]	4
11	Do you use advanced graphics in your design	Yes
12	Do you have/use material selection option in your drawing	No
13	Do you use advanced features like splines/Bsplines in your design	Yes
14	How often do you communicate with the Software provider services [from 1 to 5. 1 being least frequent and 5 being very frequent]	3
15	What sort of difficulties you face with your existing CAE Package	Slow, Problem in importing 3D model
16	How much are you ready to invest on a New, Improved CAE Package [1: less than 20k, 2: 20-50k, 3: 50-100k, 4: 100-200k, 5: 200k+]	4
17	Do you subcontract drawings	Yes
18	Would you like to share this data with CAE tool providers in Kolkata	No

Table II. Survey report of Simpson and Company

Questionnaire for CAE Tool Support in Eastern India-Kolkata		
Name of Organization: DesFAB India Ltd.		
Type of Organization: Manufacturing/Fabrication		
Establishment year: 1995		
Field of work: Manufacturing/Fabrication		
Date of survey: 02/02/2014		
Sr No	Quarries	Response
1	Do you support CAE tool application	Yes
2	What CAE software tool do you use	AutoCAD 2013, Autodesk Inventor
3	Are they Licenced versions	No
4	In what frequency do you upgrade those tools [1: 6m, 2: 1Yr, 3: 1.5 Yr, 4: 2 Yr, 5: 2+ yrs]	5
5	Are you open to using trial versions of a different CAD tool	Yes
6	Are you open to using trial versions of a different CAM tool	Yes
7	Do you use a 3D modeling software	Yes
8	Do you create a production drawing from client's drawing	No
9	Which features do you use	Modelling, assembly
10	Frequency of using those features [from 1 to 5. 1 being least frequent and 5 being very frequent]	1
11	Do you use advanced graphics in your design	No
12	Do you have/use material selection option in your drawing	No
13	Do you use advanced features like splines/Bsplines in your design	No
14	How often do you communicate with the Software provider services [from 1 to 5. 1 being least frequent and 5 being very frequent]	2
15	What sort of difficulties you face with your existing CAE Package	Editing and printing
16	How much are you ready to invest on a New, Improved CAE Package [1: less than 20k, 2: 20-50k, 3: 50-100k, 4: 100-200k, 5: 200k+]	1
17	Do you subcontract drawings	No
18	Would you like to share this data with CAE tool providers in Kolkata	No

Table III. Survey report of M/s DesFAB India

Questionnaire for CAE Tool Support in Eastern India-Kolkata		
Name of Organization: CADD Center, Kolkata		
Type of Organization: CAD/CAM Educational		
Establishment year:		
Field of work: CAD/CAM Education and Placements		
Date of survey: 22/01/2014		
Sr No	Quarries	Response
1	Which software trainings do you provide	Creo 2.0, Catia v5, NX CAD, NX CAM, ANSYS 15.0, Primavera
2	What CAE software tool do you use	SIMdesigner, XF Flow
3	Are they Licenced versions	Yes
4	In what frequency do you upgrade those tools [1: 6mts, 2: 1yr, 3: 1-1.5 yrs, 4: 1.5-2yrs, 5: 2+ yrs]	3
5	Are you open to using trial versions of a different CAD tool	Yes
6	Are you open to using trial versions of a different CAM tool	Yes
7	Do you use a 3D modeling software	Yes
8	What are the back grounds of the students [1: ITI, 2: Diploma, 3: B.Tech, 4: M.Tech, 5: PhD]	2, 3
9	students the most [1: Modeling, 2: Analysis, 3: Advanced Analytical, 4: CAM modeling and simulation, 5: CAM Programming]	1
10	Which features are most commonly used	Mass property analysis, FEA
11	Do you use advanced graphics in your design [1: never, 2: sometimes, 3: often, 4: mostly, 5: always]	3
12	option in your drawing [1: never, 2: sometimes, 3: often, 4: mostly, 5: always]	2
13	Do you use advanced features like splines/Bsplines in your design [1: never, 2: sometimes, 3: often, 4: mostly, 5: always]	1
14	the Software provider services [1: never, 2: sometimes, 3: often, 4: mostly, 5: always]	2
15	What sort of difficulties you face with your existing CAE Package	
16	How much are you ready to invest on a New, Improved CAE Package [1: Less than 20K, 2: 20-50K, 3: 50-100K, 4: 100-200K, 5: 200+K]	2
17	What is the approximate cost of the courses provided	Brochure provided
18	Would you like to share this data with CAE tool providers in Kolkata	Yes

Table IV. Survey report of CADD Center, Kolkata

Fields	Autodesk Inventor 2014	Creo 2.0
Windows 7	32 bit min, 64 bit reco	professional, ultimate, enterprize x64 edition
Windows 8.1		
Windows XP or Vista	Y	Professional x64 Edition (Base OS Service Pack 2)
RAM	4GB minimum for 500 parts assbly	3 GB RAM or higher
Disk Space	15 GB free space for installation (250GB reco)	3GB+ recommended
Video card	1280x1024 screen resolution	
Processor	Intel Pentium 4, AMD Athlon 64 with SSE2 technology, 3 GHz or greater, or AMD dual-core processor with SSE2, 2 GHz or greater recommended, or Intel® Xeon® E3 or Core i7 or equivalent with SSE2, 3.0 GHz or greater	32-bit hardware for Creo 2.0 in cases where /3GB switch is utilized
Install Media		OpenGL 3.1
Network		Microsoft

		windows, UNIX, LINUX networking
Virtual environments and storage devices	64-bit Windows 7 or Windows 8	Supported storage devices

Table V. CAD/CAM System requirements

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