CHAPTER I

1 INTRODUCTION

1.1 Concept and Context of the Study

Business organizations do not only sell; they also buy vast quantities of raw materials, manufactured components, plant and equipment, supplies, and business services. There are over 6 million businesses with paid employees in the United States alone. To create and capture value, sellers need to understand these organizations’ needs, resources, polices, and buying procedures (Kotler, Keller, Koshi, & Jha, 2009)\(^1\) (page 173). The volume of Business to Business market (B2B) is much larger than that of the Business to Consumers (B2C). B2B market comprises of inter business market as well as Government and Defence market. In a consumer market also, the sell within distribution channel till it reaches to the end-consumer, is a B2B market. Profitability of a business depends on the input cost of various purchases done by the organization. Hence effective and efficient purchases, become crucial for the organization. Thus organizational buying is a very important area of study for marketing practitioners and researchers.

Purchase of raw materials, manufactured components (bought out items), plant & equipment, and supplies concern about handling tangible product purchases. While purchase of services, or software products lead to handling intangible products. Software products are Information Technology (IT) products and Computer Aided Design/ Computer Aided Manufacturing (CAD/CAM) products. They differ in their deliveries, implementation, maintenance & repairs, customization, and upgrades.

Purchasing IT & CAD/CAM products adds a new dimension to the organizational buying. These automation technologies help the organization maintain its competitive advantage over others. The competitive advantages can be in terms of higher quality, lower costs, better end-products, or even faster deliveries (quick-to-the-market products). Purchase and implementation of various software products created what is called as ‘islands of information’ within an organization. Huge investments in these products were not helping organizations with an integrated information system. Thus a need was felt to procure software products that are sharing data & information with each other for effective functioning. Enterprise Resource Planning (ERP) system is a solution that has integrated all functions of an organization. But ERP system brings with it, fresh investment costs and data migration issues. The same problem can be faced while implementing CAD/CAM products in an organization. First problem is that the data of CAD in one department may not be similar to that in another department as different departments may have different CAD products. The second problem can be that the data of CAD may not be integrated completely with CAE or CAM directly. Third problem may be of sharing the data & information beyond the organization, to suppliers, customers etc. Thus organizational purchase has become more & more complex.

Even with huge volume and more complexity involved in B2B market, there is a meagre amount of research taking place, compared to the research in consumer market. The researches in the consumer market cannot be applied to the organizational buying. The organizational buying is process driven and a team work, while consumer buying is mainly emotionally driven and an individual job. There is no impulsive buying in organization while that may happen more often in consumer purchase. The aim of consumer purchase may be self-image while aim of organizational purchase is always for benefit of the organization. The average purchase cost, & volume and related risks for an organizational purchase will be far more than that in consumer. The products purchased will be of different types in consumer purchase and organizational purchase.

Organizational/ industrial buying (purchase) process is unique to an individual organization and it is not very much open. One has to depend on the interactions done
with the organization while selling or attempting a sell with that organization. Broad process may be known but the intricate decision making process may not be revealed; it can be only inferred upon. Impact of the tangible attribute of Purchase Decision like product features (technical specifications), price, delivery etc can be well estimated. But it is difficult to predict correctly about intangible attributes like perception of quality, support etc. So a researcher has to conduct a proper survey to find out the attributes and their impact.

On the other hand, customers are well informed through various electronic media like internet, mobile phones and even the social media. To be competitive seller in the global arena, CAD/CAM marketers have to understand what customers value most. There is no research taking place in CAD/CAM products’ selling/ purchasing patterns. The available papers are small in number and mainly refer to technical comparisons or implementation hassles in CAD/CAM. This research intends to explore the attributes of Purchase Decision of CAD/CAM products, and to what extent they impact the Purchase Decision.

1.2 Statement of the Problem

The research deals with the purchase of CAD/CAM products that are mainly software products with an exception of CAM where a Computer Numerical Control machine (CNC) can be a tangible hardware. So the factors that affect the Purchase Decision must take care of the intangibility of the products involved. These CAD/CAM products are helpful in designing the organization’s products, testing them for their working conditions (Computer Aided Engineering- CAE analysis), manufacture them through the CNC machines and manage the product data. In short these products handle the organization’s products on their total life cycle. While purchasing these products, organization has to critically determine:

- which product or products to be purchased initially
- what technical specifications fulfil organization’s need or requirements
- what are the budgets required to purchase, implement and maintaining them
- human resources, their training, & support required for the products
- any other aspects for sharing the data within and outside organization

Decision making process in an organization is a team work and not individual. The team may comprise of minimum of two persons in a small organization to a big team in large organizations. The team may have different persons who perform different roles in the organization. (Webster & Wind, 1972)\(^2\) Webster & Wind call the decision making unit of a buying organization— the buying center that consists of initiators, users, influencers, deciders, approvers, buyers, and gatekeepers. The team may have one person performing more roles or one role performed by many persons.

From a researcher’s perspective it needs to be understood how the organizations decide about purchase of CAD/CAM products. Once the requirements are fixed by the organizations, then how the decision is arrived at. In general what factors really influence the decision making process in organizations and to what extend these factors affect the decision.

The basic premise of the marketing concept is that a product (or a service) is a bundle of physical and perceived attributes, which provides a customer with a bundle of physical and perceived benefits to satisfy his/her needs and goals. (Peter & Olson, 1993)\(^3\). Three basic questions stimulate the study. What are the attributes that impact purchase of CAD/CAM & to what extent? Are these attributes interrelated- or do they impact each other? Is there any linear relationship between these attributes and Purchase Decision?

1.3 Aim and Objectives of the Study

1) **Aim**: To find relationship between Purchase Decision & attributes of CAD/CAM Products- Technical Features, Delivery & Support, Price & Commercials and Data Compatibility.

2) **Objectives**:
   a) To find out the attributes of a CAD/CAM product those affect the Purchase Decision.
   b) To find out to what extent the attributes (Technical Features, Delivery & Support, Price & Commercials and Data Compatibility) affect the Purchase Decision individually.
   c) To find whether the attributes of CAD/CAM Products (Technical Features, Delivery & Support, Price & Commercials and Data Compatibility) have any inter-relation i.e. whether they affect each other.
   d) To establish mathematical equation between Purchas Decision and attributes of CAD/CAM Products- Technical Features, Delivery & Support, Price & Commercials and Data Compatibility.

The research is all about understanding the decision making process for purchase of CAD/CAM products in an organization. The process in an individual organization may be different, but a common generalized process can be explored through this research. There are different members in the team of decision making. They will have their individual opinion about the purchase. Their collective opinion which may be influenced by a few members, may lead to a decision. It is assumed that the decision will be logical and rational one.

As stated above the study aims at finding how collectively the attributes are related to the Purchase Decision. This analysis will be a combined effect of attributes that are interrelated to one another, on the dependent variable- Purchase Decision. The combined model can be in terms of a **numerical formula** which will explain the effect of attributes of CAD/CAM Products on their Purchase Decision. Typically we are
intending a regression model here with finding the values of constants, and coefficients that can explain the Purchase Decision behaviour.

Before achieving the aim of the study, several objectives need to be achieved. The first objective of the study is to find out the attributes of a CAD/CAM products that affect the Purchase Decision. There can be so many attributes that may affect decision like technical specification, price, commercial terms & conditions, delivery conditions, technical support quality, sharing of data with other CAD/CAM systems, training, efficiency etc. Research aims in finding out which are influencing the decision and which do not influence. The Purchase Decision will be tested for its relation with each and every individual attribute. Alternatively, similar attributes can be clubbed together to test collective relation with the Purchase Decision.

The second objective of the study is to find out to what extent the attributes affect the Purchase Decision individually. All attributes may not affect in the same way. There may be some attributes that affect the decision more and some may affect in less manner. Study aims to find the quantitative value of each affecting attribute, so that they can be ranked for their impact on Purchase Decision. Once the most important attribute is known, then it becomes easier for the sellers to concentrate more on those attributes to increase their competitive advantage.

The third objective of the study is to find interdependence of the attributes. The attributes may be interdependent. Price may be increased as technical specifications are increased. Studies aims at finding the interdependence between these attributes, and then relate them to the Purchase Decision. This will provide us the clear relationship between the attributes and the Purchase Decision.
1.4 Hypotheses

Based on the Aim and Objectives, Literature Review and Pilot Study the hypotheses were developed. Following are three hypotheses studied under this research:

H1: There exists a relationship between the Purchase Decision of CAD/CAM products and individual attribute of these products- Technical Features, Delivery & Support, Price & Commercials and Data Compatibility.

The hypothesis postulates that these attributes have a relationship with Purchase Decision of CAD/CAM Products. The Testing will throw light whether the Attribute has impact on Purchase Decision, if yes, then to what extent. All Attributes may not impact in the same manner. So a Seller can focus on the Attribute(s) that impact most.

H2: The attributes of CAD/CAM products- Technical Features, Delivery & Support, Price & Commercials and Data Compatibility do not depend upon one other.

In terms of statistical analysis, we will find whether the attributes of CAD/CAM products show multi-co linearity among themselves or not. The attributes under study are Technical Features, Delivery & Support, Price & Commercial, and Data Compatibility. The study will analyse whether these attributes have multi-co linearity among them and one affects the performance of the other.

H3: A mathematical equation can be established between Purchase Decision of CAD/CAM Products & the attributes- Technical Features, Delivery & Support, Price & Commercials and Data Compatibility.

The attributes under study are Technical Features, Delivery & Support, Price & Commercial, and Data Compatibility. They have varying impact on Purchase Decision of CAD/CAM Products. We will find out whether the attributes impact Purchase
Decision significantly and will try to establish linear relation between Purchase Decision & attributes of CAD/CAM products.

1.5 Scope and Constraints of the Study

Area under Study: The research is conducted in the revenue district of Pune in the state of Maharashtra, India. It is located on the Mountain ranges of Sahyadri- the Western Ghats, at an altitude of 559 m (1863 ft). Average rain fall is 600-700 mm, most of which is in the monsoon period of June to September. The temperatures vary from 20-30\(^\circ\) C with minimum of 3\(^\circ\) C in winter and maximum of 40\(^\circ\) C in the summers. The district is blessed with 21 rivers and 19 dams. History of city Pune dates back to 16\(^{th}\) century and remained the capital of Peshwas for quite long time. Pune is cultural capital of Maharashtra and known as the Oxford of East, and Detroit of East. It attracts youth from all over India and other countries for studies. Pune is full with good eateries, hotels, cinemas, shopping places, sports complexes and thus a tourists’ attraction also.

The area is densely populated (approx. 5 Million) with the various types of industrial & multinational organizations, government & defence establishments. The area has various mechanical, civil, electrical, pharmaceutical, chemical, electronics & IT industries. As the title of the research suggests, the study was restricted to organizations that have implemented or will be implementing CAD/CAM products only.

Pune and around area was selected for its richness of the organizations. Mostly all types of industries are located out there that can use CAD/CAM products. With this scope the budget was kept under control without compromising on variedness of the industries. The area hosts multinational companies like Alpha Laval, ThyssenKrupp, Gabriel, John Deere, Behr, Tenneco, Crane Process, & Amphenol. The area hosts Indian giants like Tata Motors, Bharat Forge, Mahindra Naval Defence, Bajaj Auto, Kirloskar brothers, Thermax, Godrej & Boyce, & Zensar etc. The Armament Research & Development Establishment, High Explosive Material Research Laboratory, Ammunition Factory, Ordnance Factory, Dehu Road, Southern Command are the defence establishments.
Thus Pune and around area is a representative area of any industrial belt in the world. The area is divided in various sub-areas like Pune City, Pune Cantonment, Pirangut, Hadapsar, Pimpri-Chinchwad, Akurdi, Hinjewadi, Shivane, Satara Road, Solapur Road, Bhosari, Nagar Road, Ranjangaon, Chakan, Dehu Road etc. The area attracts very high corporate and Foreign Direct investments in India, and is the scope under this Study.

**Products under Study:** CAD/CAM products are under consideration in this study. The term CAD/CAM encompasses CAD, CAE, PLM and CAM. CAD refers to Computer Aided Design which takes care of drafting, sketching, manufacturing 2D drawings and 3D modelling. CAE refers to Computer Aided Engineering which has engineering analysis functions that can help engineers design industrial products. PLM refers to Product Lifecycle Management that takes care of managing various documents at various versions and revisions and thus managing Knowledge Base in an Organization. CAM refers to Computer Aided Manufacturing which deals with sending manufacturing commands to Computer Numerical Control (CNC) Machines. In short these are mechanical products used by mechanical industries or engineering services industries. There are Civil- Architectural, Electrical, Electronics CAD products also, which are out of scope of this study.

In the CAD/CAM product arena there are numerous products available but only 6 are recognized brands. All these brands are globally recognized, multinational CAD/CAM vendors. The brands considered in the study are:

1. Inventor from Autodesk, USA
2. Catia from Dassault Systems, France
3. NX- Unigraphics from Siemens, Germany
4. Pro/E-Creo from PTC, USA
5. Solid Works from Dassault Systems, France
6. Solid Edge from Siemens, Germany
They represent the full CAD/CAM functionalities. The respective organizations’ annual revenues for these products are more than USD 1Billion. Thus they are the leaders in CAD/CAM product market, making impact in this industry.

**Other Aspects Under Scope:** The study refers to the Purchase Decision taken in the past or the Purchase Decision which may be taken in the near future which is within one year. It does not cover any legal &/or commercial aspect of the actual software product purchase, in any way.

The scope of study covers recent past/ recent future Purchase Decisions, for 6 CAD/CAM products, for organizations in and around Pune.

**Constraints:**

1) **Piracy- Full or Partial:** CAD/CAM market being software product market has a unique characteristic of authorised license installation and unauthorised installation. The market may have some illegal installations of software products. Researcher has not given any consideration for such installations. This study does not account for any illegal software installation which is often referred to as pirated software installation. There is no data available of how many such pirated copies installed, nor is it in the scope of this study. The piracy also may exist in partial way. In an organization some software products may be purchased and some may be pirated. This situation is under-licensing or partial licensing. This study does not deal with such partial &/or under-licensing either.

2) **Huge Industry Base:** Mechanical industry in and around Pune is spread across various industrial areas. These areas comprise of tiny, small, medium and large companies. A machining center which provides services also uses drawings, but may not use a CAD software product. Finding such tiny or small industries and whether they are prospective CAD/CAM buyers is a very difficult task.

3) **Cottage industry or off-shore offices:** CAD industry can be run by a small set-up of computer systems that can be in a residential complex, bungalow or an apartment. There are Offshore office providing Engineering Services where the purchase, sale does not involve any of the Indian companies. Typically an Indian subsidiary of a
north American company may use software procured in the USA, in their night shift, via internet and provide service in their Computer Network, logging in from India. Alternatively they also can transmit the job via internet FTP site (a web site where one can use File Transfer Protocol- FTP) to download or upload the files). It becomes difficult to locate such firms and their CAD/CAM usage prediction becomes difficult.

4) **Secrecy of an Organization:** It is normal practice that organizations do not share vital data or internal information with outsiders related to finance, strategic decisions etc. There can be some constraint in finding this data on their decision making.

### 1.6 Significance of the Study

CAD/CAM touches us in our everyday life. All the products that surround us in the modern world are created, and improved by the CAD/CAM products. The use of CAD enables a mechanical engineer to design the products better and in a short amount of time. The automation techniques help designers modify old designs quickly, easily, and accurately. Newer ideas can be visualized on computer screen before they are manufactured. Aesthetical geometries can be introduced in products by powerful A class surfaces, for better looking products. Similarly better ergonomic designs can be achieved by trying various geometries that add user friendliness. The computer prototype- which is termed as ‘model’ gives exact replica of the product on the screen of the computer. Models thus created can be seen from all angles, by rotating them on computer screens. Engineers even can perform visual inspection of the assemblies and subassemblies for checking interferences, obstacles, or hindrance in them.

Cars designed in the 1980s and 1990s were not so attractive in their shapes. While today we see aerodynamic shapes of cars that are beautifies them at the same time keeps air friction (resistance) to a minimal level. After an accident, denting and painting used to take enormous amount of time and money. Today the car panels are just replaced by new once in just no time. This is possible as the designs have added Reliability and
Repeatability in the products designed today. CAE helps in optimizing the designs. The optimization can be achieved with reducing the dimensions of the product geometries. Thus while keeping the same product-life for the designed product reduction in the material can be achieved. In other words for the same material thicknesses, higher working loads can be guaranteed to the customers. CAE does computer analysis of the product for working conditions. This avoids physical prototypes to be destroyed for such tests, and saves us enormous time, and money.

An example of crash test is evident of advantages of CAE. A crash test is carried out to check the safety measures that are taken care off in a car. Earlier the car used to be physically crushed in an experimental set-up. Then the affected parts will need to be checked physically. Today there are powerful simulation techniques available that can perform all these tests on a computer without physically destroying the car. The results are reliable and trustworthy and save us time, money, material, and risk to human life involve in the tests.

CAM products generate automatic NC (Numerical Control) codes out of the designed product geometries and send them to the CNC machines. The generated codes are based on the specifications of the CNC machine such that the codes are error free. These codes are generated on very sound logical routines that take care of the CNC machine’s component and the cutting tools avoiding obstacles in the tool-path. Thus repetitive runs of NC codes are avoided giving us first time correct NC code. This avoids material wastages, and time waste of costlier CNC machines. The quality and accuracy of manufactured part are maintained by the CNC machine itself. Thus the CAD/ CAM products provide us with superior, improved designs and manufactured parts; converting an imagined Art into a physical Part. Thus we have better products which are aesthetically & ergonomically designed, with fewer prices and delivered fast and maintained easily. The products we use daily are produced using CAD/CAM products and they are fan, refrigerator, pressure cooker, grinder, mixer, oven, air conditioner, cars, bus, lift etc. The other products that affect us indirectly are truck, aero-plane, elevator, defense equipment, railways, and so on. The list is endless. This is the impact of CAD/CAM on modern Human life.
We are trying to study how Purchase Decisions of CAD/CAM products are taken by various organizations. Wrong decision can lead to wastage of investment, time, and human efforts. Organizations take a great amount of care while making these decisions about CAD/CAM product purchase. These decisions are heavy capital investment decisions. And any capital investment decision is very crucial for any organization.

This research intends to study how CAD/CAM products are purchased, which are the key attributes that are considered by organizations (big, medium, and small equally) for this decision. From academics point of view the study will provide:

1. Attributes that impact purchase of CAD/CAM products
2. Correlation between the attributes and the Purchase Decision
3. Equation defining exact relation between attributes and Purchase Decision

The CAD/CAM suppliers will know:

1. which attributes to improve upon
2. what are the relative ranks of these attributes
3. what is a supplier’s relative position in the market

The CAD/CAM purchasing organizations will know:

1. What is the general trend in market for CAD/CAM purchase
2. What are the competitors’ decision about their CAD/CAM purchase & its effects