# Table of Contents

## Chapter I: Introduction

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Preamble</td>
<td>17</td>
</tr>
<tr>
<td>1.2 History of development of information technology</td>
<td>18</td>
</tr>
<tr>
<td>• Algorithmic Logics and IT</td>
<td></td>
</tr>
<tr>
<td>• The Development of Machine Computers</td>
<td></td>
</tr>
<tr>
<td>• Modern Computing</td>
<td></td>
</tr>
<tr>
<td>• Development of Computer “Industry”</td>
<td></td>
</tr>
<tr>
<td>• From Vacuum Tube to Microprocessor</td>
<td></td>
</tr>
<tr>
<td>• The Development of the Information Machine</td>
<td></td>
</tr>
<tr>
<td>• The Internet</td>
<td></td>
</tr>
<tr>
<td>1.3 Information technology – An industry or a Product or a Process</td>
<td>24</td>
</tr>
<tr>
<td>• Usage of Information Technology</td>
<td></td>
</tr>
<tr>
<td>o In science and technology</td>
<td></td>
</tr>
<tr>
<td>o In business</td>
<td></td>
</tr>
<tr>
<td>• Transformation In Work Places and Business Processes</td>
<td></td>
</tr>
<tr>
<td>• The Indian Scenario</td>
<td></td>
</tr>
<tr>
<td>1.4 Small &amp; Medium Scale Sector</td>
<td>30</td>
</tr>
</tbody>
</table>
• Role of Information Technology in SMEs

1.5 Industrial Profile of Pune 34
1.6 The subject of research 37
Chapter I: Introduction

1.1 Preamble

Ever since inception, information technology (IT), has penetrated almost all known spheres of human life. In fact even today, new applications are reported and still surprise all of us. Ambiance of information technology in the current environment has grown to such an extent that we have started identifying prevalent era as “information society” which believed to have succeeded “industrial society”. When such a usage of words is chosen to be used, implicitly, we are recognising impact of technology on the economical environment, the society is subjected to.

Compared to other technologies, which had impact on the economies and the societies, impact of information technology had been all pervasive, and quick. This may be because of the characteristics of information technology may be different and conducive for wide-spread usage by the members of the society; compared to other technologies which were invented or discovered so far. In fact, information technology, very often is equated as smaller version of a human brain. As an application of human brain-power does not have any limits, application of information technology, would not also have any limits whatsoever.

To understand reasoning of such an impact, we need to define basic concepts of information technology, differences between information technology and other “high technologies” like bio-technology or space technology. Such comparison only will be able to explain the nature and extent of influence of information technology on the society in particular and the economy, in general.

Accessibility to the technology increases usage. Inventions and discoveries about electrical and mechanical technologies in Europe in the
18th Century resulted into almost immediate deployment of them, in terms of steam engine, incandescent lamps and the telegraphy. Obviously impact of these technologies on these societies and the nations in the vicinity is also much faster than on any other societies and the nations, which may be geographically distant. Moreover, deployment of these technologies will not only depend upon this factor alone but also on other environments to which the society in question is subjected to. We also need to explore this angle, while studying this subject.

1.2 History of development of information technology

Algorithmic logics & IT

Information Technology is based upon step-by-step procedure for data processing. It can be said that information technology was developed over last 300 hundred years by creation of such procedures or methods which could draw mathematical models of natural or man-made designs. These mathematical models are also called as algorithm.

Leibniz suggested that all the processes including social processes can be modeled into a discrete binary system; when algorithms of these processes are identified.

- These algorithmic logic and binary systems are gave rise to identify a rational numerical meaning so as to come out with dependable results regarding certain methods and further analyzing them in hardware and software layout. Though, it took almost three hundred years of efforts to convert it into the actual application of this conceptualization.
The development of machine computers

After acceptance of the concept of algorithmic logic, efforts were made to find out how it can be applied to the same for real life problem in the industry. Since during industrial revolution, information started to assume more importance to derive the correct result. Such problems were attempted with smart mechanical machines. In 1830, Charles Babbage, developed a working model of “Difference Engine” though because of the technical limitations actual construction of the “Engine” was not possible.

Since, the Difference Engine could solve only one specific mathematical problem; Babbage also developed the concept of an “Analytical Engine”. This critical method was an analytical mechanism designed for performing several numerical tasks. In today’s parlance it could be called as a computer. However it was 100 years later a programmable calculator was developed. The growing requirement for data analysis resulted into controlling the progress of automatic systems, superseding Babbage’s universal plan of a versatile analytical device. In 1890, Herman Hollerith created an automatic method in the US for calculating survey statistics which phenomenally saved the time.

In 1931 Vannevar Bush of MIT developed a “differential analyzer” for solving differential equations based series of engineering and science problems. At the very end of World War II, combining various theories of Leibniz, Babbage, Bush and the knowledge of industry mechanism of the organizations in data analysis tools after which modern computer architecture was developed.
Modern computing

In 1944 August, Hathaway Aiken and a group at Harvard designed the Mark I, the first fully programmable computer. This design was implemented by IBM. A convergence of technologies, and ideas used in the development of the Harvard Mark I lead this technology in the coming thirty years.

The methodological design intended for the computer as we see today was designed between the years 1944 to 1945 by a team of the Moore school of electrical engineering of the University of Pennsylvania. This team developed Electronic Numerical Integrator and Computer (ENIAC) - the world’s first electronic computer. The second version of this computer designed and developed by Moore was called as Electronic Discreet Variable Computer (EDVAC), with the programmable capabilities. This provided for the basic architecture of the computers even presently used such as stored-programs, binary logic of programs and computation, basic input and output units, a control unit and an arithmetic unit. In fact this structure was the road map for further development of all computers in the future.

Development of computer “Industry”

Since the years 1950 to 1960, the information technology business grew on the lines of the EDVAC. This computer industry developed the computer, which were efficient and robust. However, majority of software was custom built for the hardware for a particular application. Almost at the same time the use of electronic circuits in computers gave speed to the computers.

From vacuum tube to microprocessor
Many developments in electronics and solid state physics helped to overcome problems of the size, heat and energy constraints compelled the use of vacuum tubes in computers. The use of transistor based machines in 1958 and then in 1959, integrated circuit (IC), which had multiple transistors on a single chip, enabled hardwired circuits to reduced size to fit in a desktop calculator. This miniaturization opened the floodgates for wider computing applications beyond the traditional government and private sector applications. Hence, the projects previously not feasible because of size or cost became possible.

The microprocessor was developed in 1971 by Intel Corporation; combining each and every essential for calculation on one distinct fragment to serve several functions. Because of reduced size and high computing power, computing machines suddenly got a mass market appeal in educational and home product segment.

**The development of an information machine**

The Integrated Circuit know-how changed the formation of a versatile data mechanism which can develop, maneuver and generate result in several layouts. It led to the development of personal computers and marking importance of software which can change the computing industry. IBM computer enabled software programs for the application with every additional machine in the units of same machines. Scalability was achieved which could have software written as an organization’s computer needs expanded. Changing hardware was no longer required for new information processing needs. This reduced the cost and maintenance of the software. In other words now hardware and software could be purchased separately; which opened the market for independent software producers leading to an excessive growth of the computer business narrowed down on giving specific application based package, keeping
hardware same or even having multiple software packages running on the same hardware.

Because of this phenomenon the first personal computer - Apple II was released in 1977. Following this the diagrammatic client interaction which was called as GUI, where the device termed as “mouse”, resulting in web image stating that what you see is what you get. Also the Ethernet was entirely designed and commercialized by various other companies in the Silicon Valley. Advent of the PC also brought in software as a key industry driver and as software and prepackaged solutions became the computer industry. After the beginning of the period from 1980’s, bundled computer programs determined the design of recognition of computer machines with the customers. Bundled products like VisiCalc, Microsoft Word, PageMaker and Lotus 123 have created a need for endorsement of the particular computer machines which are suitable for their operations. Thus, after 1990’s, the computer became a data device. This device was implemented for successful and efficient applications with several tasks for analyzing data and helped to generate the right sequence.

Over the years, customized software solutions were established for large systems, the packaged software got rooted throughout the industry. With the advent of internet and further development in computers taking place in early 1990s; bundled computer programs similar to database, enterprise resource planning and internet infrastructure were used on a big level were introduced. These packaged systems could be customized to the needs of an individual user. Software enabled the flexibility and versatility in all computer based systems. Thus, software facilitated the transformation of the computer industry to information technology.

The Internet
In the later part of 1960’s, because software programs were difficult, devoted, custom-made and costly; it was difficult to share information.
Hence, the organization named as “Defense Advanced Research Project Agency (DARPA)” had taken the responsibility of an assignment for developing a process of connecting the data processing nodes to distribute all the data. This assignment was recognized by the name “Arpanet”. This was a devoted infrastructure arrangement used to connect the vital study centers located in the United States.

In this the basic concept used was to break down information into pieces (or packets) for their individual transmission across the network. The packets of information permitted multiple users on the network to broadcast the data concurrently. These data programs were useful for various users as the connection across the whole system was rearranged to reach their targets. The “store and forward” concept allowed the system to be tremendously adaptable and vigorous in nature making it reliable. This unique network communication concept coupled with the software and Personal Computers made it possible to connect more many more clients and usage of additional programs.

Few of the most noteworthy achievement for the growth of systems were the development of the Transmission Control Protocol/ Internet Protocol (TCP/IP) and Ethernet. These algorithms are used to organize data paths in and around various systems. Therefore, simultaneous access and sharing of resources from different locations by multiple users was enabled due to the creation of local area networks (LAN). Because of the basic functionality of TCP it establish an universal understanding towards the “gateways” connecting systems needed to switch over the data and sending it to its final target. This ultimately created a present day ‘network of networks’ or internet.

In brief, the history of Information Technology consists with:
• The mathematical based digital mediums of information exchange were possible due to the expansion of binary logic and architectures.

• The change started with the conversion of continuous to the fragmented data and its mathematical formats resulted in a better data stream.

• Therefore the prearranged mathematical formats resulted in enveloping and casing in every feature of data programs. It was right from the machine to computer programs and from environmental science to standard format.

• A constant miniaturization enabled smaller components with higher processing power.

• Software increasingly dominated the actual machine. It became the most prominent output for the knowledge, development and implementation of the data equipment.

• The communal dissemination of scholarly assets was connected to the execution of overall computer architecture.

1.3 Information technology – An industry or a Product or a Process

The above narration of development of information technology across last 300 years indicates uniqueness of it compared to any other technologies. Information technology, though available comparatively recently for the use of mankind as impacted almost all known spheres of human lives and will continue to do so in the future. In fact no other known technology has impacted so much on human society in such a small time that perhaps it has affected smallest of the small economies of the world.
Any technology is available to the society in any of the three forms, namely, Industry which produces a product or as a resultant product or a process that generates a product. However, in information technology, once availability of necessary hardware (product) is established, it actually can be used with the “software” (process) from anywhere in the universe to produce another customised product as an “application”, which itself become a manufacturing base (industry) for the end-user, for him to feed data as raw material.

However, for assimilation of any technology for future development of any society highly depends on level of availability of appropriate manufacturing machinery and continuous source of matching raw material with a manufacturing process that will make production economically feasible. In case of information technology, due to localization of operations and repeated and possibility of remote usage of software allows highly economically feasible outputs. This is perhaps major success factor impacted assimilation of technology in the contemporary human society in a short period of time.

Usage of Information Technology

In science and technology

The concept of algorithm and its basis for development of information processing solutions required for science and technology was logical sequel, all throughout the history of information technology. Every time with the availability of new capability in information technology, scientist and technologist used it to solve more complex problems. The journey from vacuum tubes to micro-processors has been punctuated by such events. In fact space science and aeronautical engineering owes its growth due to availability and usage contemporary information technology;
to process enormous data, which is created in real time. It is perhaps information technology only which assists the operative engineers to take instant decisions. Since there are many examples of such nature, they are not repeated here.
In business

Like most of the scientific and technological evolutions after establishing and proving firmly in their own fields, information technology also soon found applications in business sector. In fact, the company – International Business Machines – now popularly known as IBM – was the pioneer in producing machines based upon contemporary information technology for the usage at the businesses. IBM, incidentally, has proven to be the leader in business machines using information technology till date and in fact, its policy decisions has proven to be shaping information technology as whole, what it is today.

Transformation in Work Places and Business Processes

During industrial economy, it was ever increasing compulsion to process more and more data (information) everyday to remain progressive and competitive. A simple example can be the invention and usage of a mechanical typewriter used for business communication. A typewritten letter or a statement of accounts was more legible, accurate and person independent to understand compared to the handwritten letter or a statement. Industrial economy therefore was instrumental in defining and setting up ‘work processes’ at the work places to run the businesses efficiently and effectively.

During the initial phases of industrialisation to design and run these ‘work processes’ there was no alternative to utilise manual expertise from various disciplines. The industrialisation also compelled work-force to learn new techniques to take measures to make these work processes more efficient and effective. This was done with continuous evolution in job profile, job description of the work force employed and formal organisation structure separated into different business disciplines having
defined business processes as we see today emerged. History of management indicates that when this clarity of business processes was established their individual contribution to the businesses was also could be clearly demarcated. In fact, during the decades of late 70s to early 90s, this transformation of the business disciplines can be clearly seen to encompass larger sphere of operations, as follows:

**Table: 1.1 Transformation of business disciplines**

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<tr>
<th>Business Disciplines prior to ‘70s</th>
<th>Business Disciplines after ‘90s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounts</td>
<td>Financial Management</td>
</tr>
<tr>
<td>Personnel</td>
<td>Human resource Management</td>
</tr>
<tr>
<td>Sales</td>
<td>Marketing Management</td>
</tr>
<tr>
<td>Production</td>
<td>Manufacturing Management</td>
</tr>
<tr>
<td>Purchase</td>
<td>Materials Management</td>
</tr>
<tr>
<td>Electronic Data processing</td>
<td>Systems Management</td>
</tr>
<tr>
<td>Corporate planning</td>
<td>Strategic Management</td>
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**The Indian Scenario**

It is very interesting to study historical perspective of development in usage of information technology as well as evolution and implementation of business processes, in the Indian businesses.

Political restructuring resulting into independence from Britishers in 1947 was major point of pivot to information technology as well as business in India like many other sectors. This was because, for the first time independent India could take individual decisions. Since, 1951 India has completed 10 five 5 year plans along with 5 annual plans having clear focus on development of the economy. India’s five year plans are guided
by four basic objectives of growth, employment, self-reliance, and social justice. Every five year plan has specific objectives.

The second plan aimed at rapid industrialization with particular emphasis on the development of basic and heavy industries. Iron and steel, heavy chemicals, including nitrogenous fertilizers, heavy engineering, and machine building industry were the industries amongst them. Along with public sector, private sector enterprises also developed rapidly. Industrial houses took the lead to expand the existing businesses and establish new ones.

Infrastructural developments followed by industrial developments continued through various 5 years plans. Core industries were established by the government; while industrial houses took the lead to expand existing businesses or to establish the new ones.

The year 1991 is remarkable year in the history of industrial policy in India. It is known as the year of policy of liberalization, privatization, and globalization (LPG). It is the instrument of big push to the growth of economy. Signing up WTO membership by India and taking measures to attract foreign direct investments also helped number of foreign large scale companies to establish their Indian manufacturing set-ups. Leading industrial states like Maharashtra, Gujrath, Karnataka, Andhra Pradesh, Punjab and Haryana took initiatives to attract large domestic & foreign business houses to establish their factories in their states.

All large scale and core industries also prompted development of small and medium enterprises, also abbreviated as SMEs, for their own benefit. More the SMEs are clustered around any core industry or business, better is the development of the core industry or the business. Following this
convention, number of SMEs also established and developed around these core large scale industries and businesses.

1.4 Small & Medium Scale Sector

Since independence there is a rapid growth of SME sector. The government also recognised and promoted its special role of creating additional employment with low capital investment. Right from the industry policy resolution of 1948, till date, there had been efforts to promote and stabilize SME sector. There are many advantages of having SME:

1. Low investment compared to the large industry
2. Make use of locally available resources
3. Large employment generation and income distribution
4. More dedication to the jobs as promoters are technocrats themselves
5. Organisational hierarchy is shorter hence, quick decision making
6. Single person handles multiple-expertise jobs

However, there are some disadvantages too:

1. Small customer base, hence highly venerable to the buyers' business cycle
2. Perception about SME is that the productivity of SMEs is low compared to large scale units
3. Financially weak, hence new investment decisions are only 'need based'
4. The decision making is owner centric, than professional
5. Modern management techniques like Information Technology may be known but less practiced
Being aware of all these, large industries are also establishing their manufacturing bases at such locations; where there is already a substantial presence of SMEs. In fact, SME emerged as an active and energetic sector of the economy, contributing to 40% of the gross value output of the manufacturing sector by the end of Seventh Plan period.

The definition of SME had been getting modified since beginning. SP Gupta study group in 2001 suggested following definitions of tiny, small and medium scale sector:

1. Tiny units: up to Rs. 10 lakhs investment in plant & machinery

2. SSI units: Rs. 10 lakhs to Rs. 1 crore investment in plant and machinery

3. Medium unit: Rs. 1 crores to Rs. 10 crore investment in plant and machinery

Moreover, for the first time, SP Gupta study group and later in 2004, National commission on Enterprises in the unorganised/informal sector headed by Dr. Arjun Sengupta as Chairman, identified that lack of technology up-gradation and modernisation was one of the issues in SME sectors and recommended the government to set up a special technology up gradation and modernisation fund for this sector.


The basic objective of this act was to facilitate the promotion and development SMEs and to enhance the competitiveness of them.

The MSME Act provides following definitions of MSME:
(a) If we consider the study of the organizations involved in the production or manufacturing of products relating to any business specifically mentioned in the initial plan to the Industries Development and Regulation act, 1951, as:

(i) If the investment in plant and machinery does not exceed more than twenty five lakhs rupees; then it is defined as a micro venture

(ii) In case the investment in plant and machinery is more than twenty five lakhs rupees but does not exceed more than five crore rupees; it is termed as a small venture

(iii) For a medium venture, the investment in plant and machinery should be more than five crore rupees but should not exceed more than ten crore rupees.

(b) In the case of the ventures involved in offering or delivering of Services, as:

(i) In case of a micro venture, the outlay in the tools should be not more than ten lakhs rupees;

(ii) For a small venture, the outlay in tools should be more than ten lakhs rupees but should not exceed more than two crore rupees.

(iii) If the outlay for tools, is more than two crore rupees but does not exceed more than five crore rupees a medium enterprise then it is termed a medium venture
Role of Information Technology in SMEs

SMEs have almost 40% share of production in the manufacturing sector by seventh Five Year Plan which underlines importance of SME sector. Owners of SMEs are experts in their own field of specialisation and at the same time keep their expenses low. Hence there will be always a need to cut down expenses by means of automation – may be of the manufacturing process or of the business process. Information Technology has given them opportunity to automate their repeated processes and perform same more accurately. Thus use of Information Technology in manufacturing processes or in the business process will increase productivity of the SME. SME unit can incorporate Information Technology in following of their manufacturing/business processes:

a. Basic Office Automation
b. Financial Accounting
c. Purchase & Inventory Control
d. Production Planning & Control
e. Payroll Processing
f. Design & Drawing
g. Project Management
h. Marketing & Sales Force automation
i. Customer service
j. Email (messaging)
k. Web site
l. Enterprise Resource planning (ERP)

Few of the SMEs may be using applications like on-line payment gateways or even video-conferencing for the specific purposes.
1.5 Industrial Profile of Pune

Strategic importance of Pune

Historical

East India Company and then the Queen established British rule in India in first quarter of 18th Century. However, before this, for two centuries, Marathas ruled the Deccan from their capital city of Pune. Thus Pune had been developing politically, economically, culturally and as one of the business centre for almost three centuries. In fact, in British regime too, Pune was their operating centre, before being shifted to Mumbai and Kolkata.

Geographical

Geographically, Pune has a very unique position. Perhaps, for this reason only it has been chosen as capital city by Shri Chhatrapati Shivaji Maharaj – the Maratha King who established Maratha Raj. Pune as the capital city was continued by their Prime Ministers – The Peshavas, in subsequent years. Pune is surrounded by hills of the mountain Sahyadri, at the height of 2000 ft. from the sea level. It is 200 kilometers from nearest port – Mumbai. Pune also has its own domestic and international airport.

Weather of Pune is also very moderate. No season is extreme. Maximum temperature in summer is $41^\circ$ C while the temperatures in winters can go pleasantly low up to $5^\circ$ C. Monsoon in last about 100 years has not crossed rainfall of 28” per year.
Education & Culture

Because of its historical background, Pune has been recognised as a city of pool of talented people. Formal education right from pre-school to the University education, almost in all disciplines is available in Pune; which helps to create a continuous supply of experts to the industry. As large population of Pune is educated, culture of Pune is of very sophisticated nature. Citizens of Pune are calm and quiet by nature.

Industrial Estates

In case of Pune, Maharashtra Industrial Development Corporation (MIDC), was established to promote industrial estates in the year 1960 by creating necessary and conducive infrastructure for development of the core large industries and SMEs. As of today, Pune district has industrial estates at Pimpri-Chinchwad, Hadpasar, Jejuri, Saswad, Baramati, Kurkumbh, Rajangaon, and Chakan. Pune is also being developed as one of the favoured destinations for Information Technology. Rajiv Gandhi Technology Park at Hinjewadi, similar privately owned parks at Kharadi, Kalyaninagar and Magarpatta City also have number of internationally famous Information Technology companies.
The first such industrial area came up on Pune-Mumbai Road at Chinchwad, Pimpri and Bhosari area in the year 1962. Amongst the large industries Hindustan Antibiotics, the Bajaj Group, the Tata Group, the Kirloskars, the Garwares and the Swedish Group – Sandvik Asia, Alpha Laval, Atlas Copco, SKF, The German group – Thyson Krupp, KSB Pumps, etc., were the prominent business houses to establish factories in these MIDC areas to manufacture variety of engineering products.

To cater to the needs of these large scale industries, technopreneurs soon started appropriate SME units, in the vicinity of these industries. These SME units were in production of components and subassemblies required by the large scale industries. The industrial culture cultivated in the large industries also started percolating to these SMEs gradually due to the business association. Large scale industries
insisted upon the SMEs to incorporate their drawings and designs and quality assurance methods as a primary requirement. Large scale industries also wanted that the SME - ancillaries with them - should make it certain to follow their other business processes, such as inventory control and supply management. Hence, it was not only the technology, but also the best of the business processes and practices from the large industries were being followed by SMEs up to some extent.

Because of the overseas association or better exposure to contemporary technology, large scale industries are quick to evaluate and adopt new developments in the technology. This has improved their efficiency and consequently increased contribution in the business. This is possible for them mainly because of availability of adequate funds to purchase and deploy the new technology. In case of SMEs this may not be possible because available funds are mostly deployed for running the operations judiciously to remain competitive.

1.6 The subject of research

The researcher, during his employment with one of the service providers of e-commerce services, viz. Electronic Data Interchange (EDI), visited number of large scale and their ancillary SME units in Pimpri-Chinchwad and Bhosari industrial area. After the discussion with the number of techno-entrepreneurs, who were the proprietors, partners, chairmen, and the managing directors, the researcher experienced that there were many issues for implementation of Information Technology in SMEs.

Thus, the subject of research - ‘an empirical study of impact of information technology on improving business processes in small and medium sectors’ was chosen, which attempts to study and explore technology and business parameters which could have impacted the usage of information
technology in SMEs in Pune. The subject of research also makes an effort to understand the business processes followed at SMEs and tries to find out reasons for present conditions of the deployment of Information Technology for improvement of business processes. It also tries to assess key drivers responsible for arriving at the current status.