A Project report on

“Automation Industry”

Under the Partial Fulfillment

Of

“MIT School of Distance Education”

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“PGDBA in Operations Management”
MIT SCHOOL OF DISTANCE EDUCATION, PUNE.

SUBMITTED BY

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Year 2023-2024

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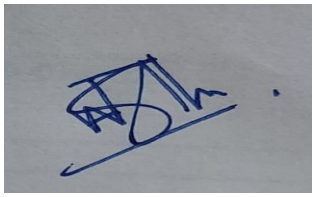

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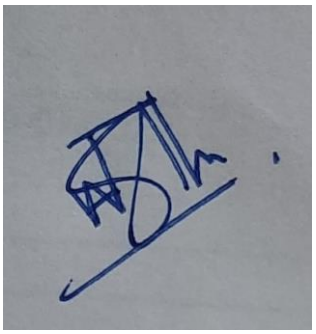
DECLARATION

I hereby declare that this project report entitled “Automation Industry” bonafide record of the project work carried out by me during the academic year 2023-2024, in fulfillment of the requirements for the award of “PGDBA” of MIT School of Distance Education. This work has not been undertaken or submitted elsewhere in connection with any other academic course.



Signature of Student

(ABHIJIT PRAKAS RASKAR)

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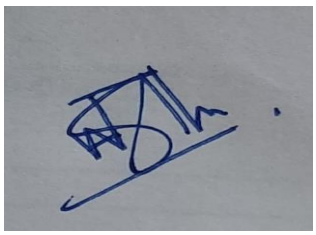
Date: - 31/07/24

ACKNOWLEDGEMENT

I would like to take this opportunity to express my sincere thanks and gratitude to faculty of MIT School of Distance Education, for allowing me to do my project work in your esteemed organization. It has been a great learning and enjoyable experience. I would like to express my deep sense of gratitude and profound thanks to all staff members of MIT School of Distance Education for their kind support and cooperation which helped me in gaining lots of knowledge and experience to do my project work successfully.

At last, but not least, I am thankful to my Family and Friends for their moral support, endurance, and encouragement during the project.

Sign: - 

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Preface

This comprehensive project has been undertaken to fulfill the partial requirements of the MBA program at MITSDE. Automation is the use of machines, control systems and information technologies to optimize productivity in the production of goods and delivery of services. The correct incentive for applying automation is to increase productivity, and/or quality beyond that possible with current human labor levels so as to realize economies of scale, and/or realize predictable quality levels. The incorrect application of automation, which occurs most often, is an effort to eliminate or replace human labor. Simply put, whereas correct application of automation can net as much as 3 to 4 times original output with no increase in current human labor costs, incorrect application of automation can only save a fraction of current labor level costs. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provides human operators with machinery to assist them with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements while increasing load capacity, speed, and repeatability. Automation plays an increasingly important role in the world economy and in daily experience.

With a decline in customs duty, increased presence of international players, and cost pressures on manufacturers, the price realizations and margins for automotive component companies are expected to be under pressure. This project will include a detailed product profile auto ancillary sector. Also, we will be studying the market scenario of the automation industry of India and an analysis of the major players of the country, total number of companies, their market share and various concepts of marketing such as demand and price determination, life cycle stages will also be investigated. The various economic, industrial and trade policies will also be touched upon. Analyzing the financial analysis of the automation industry will also be a part of this project. The macro and microenvironments will also be analyzed with the help of PESTEL, SWOT and five forces model. And lastly, the futuristic scenario of the auto ancillary industry in India as well as globally will be investigated.

Chapter 1: INTRODUCTION

1.1 Introduction to Automation Industry:

Automation is a discipline that includes knowledge and expertise from various branches of engineering including electrical, electronics, chemical, mechanical, communications, and more recently computer and software engineering. The manufacturing sector is the backbone of any economy since it helps in the overall growth of productivity, and employment, and it also strengthens agriculture and service sectors. The majority of the manufacturing industries today are facing the challenges of global competition. In the quest for survival and growth, these industries have to improve their performance by way of improving quality, productivity, efficiency, equipment utilization and reducing wastage, energy consumption, maintenance and breakdown, etc. The success of a manufacturing company will be determined by its ability to become globally competitive and successfully integrate with the emerging globally extended enterprises. Automation & instrumentation plays a very important role in the productive operations of manufacturing industries. To operate a plant efficiently and effectively, it is necessary not only to measure various parameters such as pressure, temperature, flow, conductivity, level, and others; but also to automatically control or regulate some of them. Control and instrumentation devices help to measure and regulate various process parameters. They operate on diverse principles - mechanical, electrical and electronics, pneumatic, and hydraulic. Companies wanting to become agile, competitive, and globally networked must extensively deploy automation.

With India's gradual integration with the world economy automation will play an important role in bringing down the cost. Besides costs, automation will also help increase productivity, aesthetics, and delivery systems. Operational effectiveness, and profit pressures require manufacturing to contribute and the industry has to work together to enable a compliant manufacturing environment that delivers product to plan with minimal cost and risk. The role of automation technologies is thus crucial in facilitating processes that enable measurement and control, ensure optimum efficiency, and increase productivity.

Automation is also the key to maintaining consistency & quality and conforming to safety, environmental, and a host of other stringent regulatory standards. Automation involves a very broad range of technology including telemetry and communication, PLC, SCADA, DCS, electro-optics, process measurement and control, sensors, wireless applications, systems integration, test measurement, and many more. Automation is used in various manufacturing industries like Cement, Steel, Chemical, Metal, Power, Oil and gas, Food processing, Pharmaceutical, etc. Each of these industries used different degrees of automation and Instrumentation in all or part of its manufacturing process.

India, due to the large size of its domestic market, has been very attractive for international companies for long. It was only due to political and economic barriers the automation solutions took time to reach the Indian shores. The other big challenge in India was opposition from the workers. Automation has always had the negative image of being a job killer. During the late 1980s, when the process of automation began taking a foothold, with willing political support and able technical advice, there was tremendous apprehension and protest. Popularly known as `computerization', it was apprehended by many trade unions in India that such computerization (automation) would make labor redundant and hence would lead to joblessness. However, with the force of liberalization gradually setting in during the early 1990s leading to the increased pace of economic growth, the availability of jobs and increase in wages wiped out the earlier apprehension.

Automation had its economic relevance. In an earlier protected domestic market environment, most companies had adequate demand for their products and hence had little incentive to modernize their activities. However, in an open economic environment, with competition coming in from the rest of the world, these businesses needed to focus on quality and reliability in production and emphasize customer needs. Automation proved to be a panacea for quality and reliability in production, leaving space for the business organizations to focus more on market and customer needs.

Industrial automation or numerical control is the use of control systems such as computers to control industrial computers to control industrial machinery and processes, reducing the need for human intervention. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with the physical requirements of work, automation greatly reduces the need for human sensory and mental requirements as well. Processes and systems can also be automated.

The Indian markets are slowly beginning to feel the stimulus for the instrumentation, control, and automation industry. Today, the growing awareness among the Indian consumer has ensured that the process industry has the right mix of technologies that can beget the growth opportunities, that the industry has been eyeing and seeking for a long time now. Indian automation is advancing at a fast pace, yet it is one area that can never be achieved and admired – it is something that needs constant innovation and identification of trends in technology and the innovations that thrust the implementation of automation in other countries – as it is a development that will always impact the future of automation in India. While everything may seem perfect on the face of it, India still has much to worry about regarding the state of innovation in the automation industry. Like always, it is really in the hands of the decision-makers in each industry to bring home the best that technology has to offer.

An expert who has been implementing projects for the most efficient plants across the country believes that choosing the right automation combinations facilitates the integration of manufacturing processes with business systems. It reduces the dependency on goods that are imported from industrialized countries, instead making India produce the best quality within the reach of the users and of course at a much more affordable price. For instance, manufacturing something as important as steel can be so easy and abundant by putting in place the right automation technologies that it will drastically reduce the need to import the raw material for manufacturing so many commodities, including automobiles. Recently, India has needed automation in almost every industry. Every industry needs a boost as only high-cost plants are automated in the present-day scenario. Technologically oriented industries such as power plants, stones and earth industries, glass and ceramics, iron, steel, non-ferrous metal production, rolling mills for steel and aluminum sheets, chemical and pharmaceutical, petro, pulp, cardboard and paper, the food, mining, oil and gas and industries relating to the

environmental protection such as drinking water, sewage plants, incinerating plants and so on are all included in the purview of process industries, yet, each of these industries consists of at least one part of an entire process requires advanced automation, where it is lagging.

Though it is impossible to pinpoint one industry, automation should be aimed at improving public life at large. Public sector industries that directly affect the lives of the people, such as power, water, and transportation need to be given a boost. Wireless, including WWAN, e.g. GPRS, and WLAN, e.g. Wi-Fi, and upcoming Wi-Max are India's future technologies. Understanding this need for automation in the power sector, the government has in the 2010 Union budget, set down a plan to create and harness alternative sources of power using automation. Automation must be rightly implemented in this sector if India has to achieve its goals to its fullest potential,the technology related to harnessing solar power can be categorized into several key areas related to materials (polysilicon), cells, modules and the remaining portion normally referred to as balance-of-systems (BOS). In terms of manufacturing technology for cells and modules, India is on par with other countries as evidenced by exports to Germany, the US, and other markets (this is largely because the Indian industry uses manufacturing equipment from global companies). There is a difference, though in that the degree of automation in India is broadly speaking, less compared to Germany and the US. As the volume of production goes up and the drive for higher cost efficiency continues, we anticipate that the gap in automation will be bridged in the coming year. India faces issues related to infrastructure, thus shifting more focus to the industrial design. For example, the GPRS stability is relatively lower than in other countries, i.e. the auto-reconnect and auto-recovery mechanism is more critical in India.

On the other hand, due to the weather (temperature and humidity), dust and power supply frequencies are too unstable, which the product design should regard. As the Indian industry has adopted enterprise solutions for business processes; it should also consider collaborative systems to bring out the best business value from these technologies. Several companies adapt to Enterprise Resource Planning (ERP) for business processes, but falter at the lack of basic plant automation and it leads nowhere. This is even though India's manufacturing sector is a crucial part of the country's progress, heavily dependent on the level to which one can adopt

and implement automation. Automation in India has come a long way since the early 1990s and its place in growing the country's GDP is crucial as India must have a strong manufacturing base that can see its economy rise – and automation is an integral part of that process. It is the responsibility of the suppliers of automation systems and instrumentation to focus their product development strategies even more on customer benefit and also educate them about the latest possible ways to most efficiently implement them. Recently it is important to achieve a standardized and modularized plant enabled with enhanced communication and smartness. Manufacturers must decide to better their product development skills instead of leaving it to their competitors.

This will also allow the suppliers of automation solutions to be constantly prepared to predict future technology trends. System integration and innovative service concepts for operations that rely on online remote maintenance and remote support, remote optimization and hotline services as well as intelligently combined service packages are today of utmost importance. Innovative logistic concepts like Supply Chain Management (SCM) also enhance technology by making it faster, more flexible, and more responsive. Customer Relationship Management (CRM) too is a concept that will be a reality in the future. While lack of skill to implement most technology seems to be one of India's biggest concerns, experts believe that the scenario is not as bleak as before. The global market for process automation has grown to USD 94.2 billion in 2010. The growth rate for the decade is estimated to be at 4.4%. While many have always thought the US is the dominating force for technology, India is fast catching up, aiming to achieve automated factories and processes.

This has been in India's vision for a long time now that will enable customers to order online, with secured electronic transactions and even allow them to pick the best price, size, and color. Intelligent robots and sophisticated machines that smoothly and rapidly complete a process are no longer an alien concept in India. India has lived up to its promise of having remote-controlled automation processes in manufacturing and maintenance applications. Today, India has realized the power of communication in plants with powerful and unmanned super-robots that work on networked intelligence being widely available and accepted.

1.2 Objective

The objective of the study is to understand the Automation Industry in India. Some of the key objectives of this report are to:

- study the market trend of the industry
- study the types of products in the automation industry
- Do the industry analysis through PESTEL, Porter's five forces, and SWOT analysis
- Factors that determine demand in the automation industry

1.3 Scope:

The automation industry report classifies the global market of factory automation based on different products, applications, and geographical analysis; forecasting revenue and analyzing trends in the market

1.4 Importance:

Having comprehended the importance of automation for the success and progress of the industrial set-up and thereby the country, today many companies are making large investments in bringing the latest technologies for the processes. Today, the manufacturers have also discovered the opportunity that awaits them in almost all production facilities in vertical industries, thanks to the awareness of the customers about the latest technology innovations. The demand for technology and the subsequent compliance by the manufacturers has put India on a path of economic growth. Today, the competition among manufacturers has created many advantages for the customers as far as the use of automation is concerned.

India, as one of the world's fastest-growing economies, has to technologies at a rather quick pace. India's growing foreign trade, rising internal consumer demand, growth in infrastructure growth as

well as the revival from the economic slowdown has only given the entire financial setup a new lease of life. India has now realized the importance of developing its strength with automation instead of being the smaller ally of the world. Automation is the answer to India's pursuit of being a world-class industrial competitor. This is a feeling that is contagiously spreading across all industry verticals and everyone wants to use automation from student library to hospitals to manufacturing plants.

India, along with China is fast gaining much control in the field of automation, which until now, the USA and Western Europe enjoyed. India's reliance on automation for power plants, refineries, and chemical and metal production is increasingly growing. Today, India like the highly industrialized countries is looking at improving the quality of its products as well as giving consumers much choice because even the present-day consumer is very market-conscious and understands his requirements better than before. Automation is also needed to enhance the process safety and plant availability as well as efficiently use the limited energy resources and try to be as sustainable as possible. Automation is a single solution to achieving quality as well as the environmental balance. Apart from this, the growing interface, optimization, quality control, and product tracking are a few advantages that India has now estimated to receive from higher automation controls.

Higher accuracy and better interfaces are the trends that can help India much along with the intelligence and remote diagnostics that automation processes today bring along. Decentralized automation which enables the intelligent dispersing of automation components across the plant like smart pumps has become common in many plants in India, allowing a much improved level of interaction and communication within a plant.

Recently, automation has been gaining importance even in the medium and small units, unlike earlier when its focus area was restricted to large manufacturing industries. Smaller industries and manufacturing units are beginning to see automation in a new light because of their low productivity. With the automation equipment becoming more usable and affordable, the cost-benefit works in favor of these small industries – in turn, driving automation further. Today, the Indian automation industry is estimated at Rs 10,000 crore and is only growing at a fast

pace – as much as 25 percent per annum. This is not just a good graph, but also an indication that in the years to come automation will see only more positive acceptance in industrial processes. India's greatest advantage lies in the fact that it has no pressure to choose technologies like the Western countries. Fortunately, while everyone keeps an eye on industrial progress in India, we are not constantly watched and scrutinized like the US or Germany, thus giving us the freedom to choose whatever technology we think is best for our set-up, most automation products have become commodities that are available in abundance, thus equally vulnerable to price reductions and stiff competition. Recession makes the competition more brutal with the basic features and functions of PLC and DCS systems being replicated to bring down costs and make them available to low-budget businesses. It is also making the software easily imitable, through functional equivalents.

1.5 Advantages & Disadvantages of Automation

The main advantages of automation are:

- Increased throughput or productivity.
- Improved quality or increased predictability of quality.
- Improved robustness (consistency), of processes or products.
-

The following methods are often employed to improve productivity, quality, or robustness.

- Install automation in operations to reduce cycle time.
- Install automation where a high degree of accuracy is required.
- Replacing human operators in tasks that involve hard physical or monotonous work.[3]
- Replacing humans in tasks done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc.)
- Performing tasks that are beyond human capabilities of size, weight, speed, endurance, etc.

- Economy improvement: Automation may improve in economy of enterprises, society, or most of humanity. For example, when an enterprise invests in automation, technology recovers its investment; or when a state or country increases its income due to automation like Germany or Japan in the 20th Century.
- Reduces operation time and work handling time significantly.
- Frees up workers to take on other roles.
- Provides higher level jobs in the development, deployment, maintenance, and running of the automated processes.

The main disadvantages of automation are:

- Security Threats/Vulnerability: An automated system may have a limited level of intelligence, and is therefore more susceptible to committing errors outside of its immediate scope of knowledge (e.g., it is typically unable to apply the rules of simple logic to general propositions).
- Unpredictable/excessive development costs: The research and development cost of automating a process may exceed the cost saved by the automation itself.
- High initial cost: The automation of a new product or plant typically requires a very large initial investment in comparison with the unit cost of the product, although the cost of automation may be spread among many products and over time.

Chapter 2. Growth and Evaluation of Automation Industry in India

Over the past two decades, India's service sector has gained a reputation in the world market for its high quality and low cost. But the same cannot be said about its manufacturing sector. Indian manufacturing, barring a few items, hardly has any significant global presence. However, in recent years, with the ease in foreign investment norms, several foreign companies have set up businesses in India. The global as well as domestic markets required meeting customer expectations, for which the traditional approach followed by domestic companies proved inadequate. The high quality and quantity of the products made by international companies helped to transform the Indian market.

During this period, the concept of using industrial automation techniques started creeping into plant designs. As a result, the automation industry in India began taking shape and growing. The automation solutions brought about three major changes in the production plants. First, it made product quality better and consistent. Second, it increased the quantity produced by several times; and third, It made the plants safer places to work, minimizing the risk of accidents.

The genesis of automation began with the introduction of Distributed Control Systems (DCS) and Programmable Logic Controllers (PLC) during the late 1960s. Companies like Honeywell, Yokogawa, Rockwell Automation, and others, invested heavily in research and development. These companies were competing against each other and thus made proprietary products that were not mutually compatible. The non-compatibility of proprietary products limited the popularity of these products. This gave way to open-source and inter-compliant products. This not only brought the prices down but also increased the pace of development.

Developments in the communication field also helped the cause. The most important of these was Transmission Control Protocol/Internet Protocol (TCP/IP), which provided a new dimension to remote input/output control. Other new communication protocols like Fieldbus, Profibus, Modbus, etc., made control faster and much more reliable. These protocols have the advantage of using both analog and digital signals. The recently developed wireless communication is attracting many industry experts. With all these developments, the

automation industry started growing rapidly with its applications becoming indispensable in almost every manufacturing sector.

The Indian automation industry is all set for manifold growth with steel majors and other players in the metal industry announcing massive expansion plans in the country. The Indian automation industry of Rs 4000 crore is growing at an annual rate of 20-25 percent as players in the metal industry are planning massive production expansion." said Ravi Uppal, president of, the Automation Industry Association of India (AIA). Major steel companies would augment Indian steel manufacturing capacity to 120 million tons from 38 million tons. The automation industry would experience a significant increase in demand. Apart from steel, there is a sign of demand increase from other metal industries. The automation industry said medium and small manufacturers would play a significant role in the demand chain. The penetration of automation products has been low as only large manufacturers have been using it but small and medium players could draw significant benefits by automating. Several international players were considering India as a development hub of automation products. Several overseas companies had already set up offices in India to develop automation products and around 12,000 people were working with them. The manpower requirement in the industry was growing at 5-10 percent per annum.

The Steel and the Oil and Gas industry were perhaps the first to automate followed closely by Cement. The Oil and gas industry from Oil extraction thru refining up to transportation right up to retailing has harnessed the benefits from the early days progressively going on to Level 3 quite early The cement industry too has been an early starter with most plants in India now automated and going in for increased sophistication as early as the 90s.

The Steel industry too was quick to take full advantage from the early 70s and is perhaps one of the biggest users of automation systems alongside Oil & Gas and Cement It is these basic industries that set the trend for others to follow in Chemical, Energy, Food Pharma and the like. In the discrete automation area, the coming of age of the Indian automotive industry has given a spurt to factory automation, robotics, and motion control A very heartening piece of news for industry pros in the recent past .With modern Indian made machinery you now have

a host of Indian manufacturers in Plastics, Printing and Packaging, Textiles, Tyre and Rubber and Material handling equipment using Drives PLCs and HMIs to run their machines and make them as good as some of the best worldwide Most elevators you ride on in Indian multi-stored buildings are quick and comfortable because they are run by AC drives.

2.2 Product Profile:

2.2.1 Categories of Automation Products:

In recent years, the manufacturing field has witnessed the development of major automation alternatives. Automation product can be categorized as follows.

1. Information technology (IT) automation: This encompasses a broad spectrum of computer technologies used to create, store, retrieve and disseminate information.

2. Computer-aided manufacturing (CAM): This refers to the use of computers in the different functions of production planning and control. CAM includes the use of numerically controlled machines, robots and other automated systems in manufacturing.

3. Numerically controlled (NC) equipment: NC machines are programmed versions of machine tools that execute operations in sequence, on parts or products. Individual machines may have their own computers for the purpose; such tools are commonly referred to as computerized numerical controlled (CNC) machines. In other cases, many machines may share the same computer; these are called direct numerical controlled machines.

4. Robots: This type of automated equipment can execute different tasks that are normally handled by a human operator.

5. Flexible manufacturing systems (FMS): A flexible manufacturing system combines NC machines, industrial robots, and other types of industrial automation into one automation

system. A FMS would typically produce similar products and parts but still be flexible enough to change parts or processes.

6. Computer integrated manufacturing (CIM): A CIM system is one in which many manufacturing functions are linked through an integrated computer network. These manufacturing or related functions include production planning and control, shop floor control, quality control, etc

2.2.2 Main Body Of Automation:

Main Body of Automation System consists of the following parts:

SCADA - Supervisory Control and Data Acquisition

PLC - Programmable Logic Controller

DRIVES - Variable Speed Drives

SENSORS -Transducers, Feedback equipments

AUXILIARIES - Converters, Power Supplies, Different Communication mediums etc.

SCADA: stands for Supervisory Control And Data Acquisition. It generally refers to an industrial control system: a computer system monitoring and controlling a process. The process can be industrial, infrastructure or facility based as described below: Industrial processes include those of manufacturing, production, power generation, fabrication, and refining, and may run in continuous, batch, repetitive, or discrete modes. Infrastructure processes may be public or private, and include water treatment and distribution, waste water collection and treatment, oil and gas pipelines, electrical power transmission and distribution, and large communication systems. Facility processes occur both in public facilities and private ones, including buildings, airports, ships, and space stations. They monitor and control HVAC, access, and energy consumption.

A SCADA System usually consists of the following subsystems:

A Human-Machine Interface or HMI is the apparatus which presents process data to a human operator, and through this, the human operator, monitors and controls the process. A supervisory (computer) system, gathering (acquiring) data on the process and sending commands (control) to the process. Remote Terminal Units (RTUs)connecting to sensors in the process, converting sensor signals to digital data and sending digital data supervisory system. Programmable Logic Controller (PLCs) used as field devices because they are more economical, versatile, flexible, and configurable than special-purpose RTUs Communication infrastructure connecting the supervisory system to the Remote Terminal Units.

Here is, in several industries, considerable confusion over the differences between SCADA systems and Distributed control systems (DCS).Generally speaking, a SCADA system usually refers to a system that coordinates but does not control processes in real time. The discussion On real-time control is muddied Some what by newer telecommunications technology, enabling reliable, low latency, high speed Communications over wide areas. Most differences between SCADA and Distributed control system DCS are culturally determined and can usually be ignored. A communication infrastructures with higher capacity become available, the difference between SCADA and DCS will fade.

The term SCADA usually refers to centralized systems which monitor and control entire sites, or complexes Of systems spread out over large areas (anything between an industrial plant and a country).Most control actions are performed automatically by remote terminal units ("RTUs") or by programmable logic controllers ("PLCs"). Host control functions are usually restricted to basic overriding or *supervisory* level intervention. For example, a PLC may control the flow of cooling water through part of an industrial process, but the SCADA system may allow operators to change the set points for the flow and enable alarm conditi ons, such as loss of flow and high temperature, to be displayed and recorded. The feedback control loop passes through the RTU or PLC while the SCADA system monitors the overall performance of the loop.

Human Machine Interface:

A Human-Machine Interface or HMI is the apparatus which presents process data to a Human operator, and through which the human operator controls the process.

An HMI is usually linked to the SCADA system's data bases and soft ware programs, to provide trending, diagnostic data, and management information such as scheduled maintenance procedures, logistic information, detailed schematics for a particular sensor or machine, and expert-system troubleshooting guides .

The HMI system usually presents the information to the operating personnel graphically, in the form of a mimic diagram. This means that the operator can see a schematic representation of the plant being controlled. For example, a picture of a pump connected to a pipe can show the operator that the pump is running and how much fluid it is Pumping through the pipe at the moment. The operator can then Switch the pump off. The HMI Software will show the flow rate of the fluid in the pipe decrease in real time. Mimic diagrams may consist of line graphics and schematic symbols to represent process elements, or may consist of digital photographs of the process equipment overlain with animated symbols.

The HMI package for the SCADA system typically includes a drawing program that the operators or system maintenance personnel use to change the way these points are represented in the interface. These representations can be as simple as an on-screen traffic light, which represents the State of an actual traffic light in the field, or as complex as a multi-projector display representing the Position of all of the elevators in a skyscraper or all of the trains on a rail way.

An important part of Most SCADA implementations are alarms. An alarm is a digital Status point that has either the Value Normal or ALARM. Alarms can be created in such away that When their requirements are met, they are activated. An example of an alarm is the fuel tank empty light in a car. The SCADA operator's attention is drawn to the part of the system requiring attention by the alarm .

E mails and text messages are often sent along with an alarm activation alerting managers along with the SCADA operator.

Around the world, SCADA systems control Electric power generation, transmission and distribution: Electric utilities use SCADA systems to detect Current flow and line voltage, to monitor the operation of circuit breakers, and to take sections of the power Grid online or offline. Water and sewage: State and municipal water utilities use SCADA to monitor and regulate water flow reservoir

levels, pipe, pressure and other factors. Buildings, facilities and environments: Facility managers use SCADA to control HVAC Refrigeration units, lighting and entry systems.

Manufacturing*:* SCADA systems manage parts inventories for just-in-time manufacturing, regulate industrial automation and robots, and monitor process and quality control.

Mass transit: Transit authorities use SCADA to regulate electricity to subways, trams and trolley buses; to automate

traffic signals for rail systems : to track and locate trains and buses; and to control railroad crossing gates.

Traffic signals: SCADA regulates traffic lights, controls traffic flow and detects out-of-order signals. Real-Time Monitoring and Control Increases Efficiency and Maximizes Profitability

A SCADA system performs four functions :

1. Data acquisition
2. Networked data communication
3. Data presentation
4. Control

Data Acquisition: First, the systems you need to monitor are much more complex than just one machine with one output. So a real-life SCADA system needs to monitor hundreds or thousands of sensors. Some sensors measure Inputs into the system (for example, water flowing into a reservoir), and some sensors measure outputs (like valve pressure as water is released from the reservoir). Some of those sensors measure simple events that can be detected by a straightforward on/off switch, called a discrete input (or digital input).For example, in our simple model of the widget fabricator, the switch that turns on the light would be a discrete input. In real life, discrete inputs are used to measure simple states, like whether equipment is on or off, or tripwire alarms, like a power failure at a critical facility. Some sensors measure more complex situations where exact measurement is important. These are analog sensors, which can detect continuous changes in a voltage or current input. Analog sensors are used to

track fluid levels in tanks, voltage levels in batteries, temperature and other factors that can be measured in a continuous range of input.

For most analog factors, there is a normal range defined by a bottom and top level. For example, you may want the temperature in a server room to stay between 60 and 85 degrees Fahrenheit. If the temperature goes above or below this range, it will trigger a threshold alarm. In more advanced systems, there are four threshold alarms for analog sensors, defining Major under or Minor over, Major over alarms.

2. Data Communication :

In our simple model of the widget fabricator, the network is just the wire leading from the switch to the panel light. In real life, you want to be able to monitor multiple systems from a central location, so you need a communications net work to transport all the data collected from your sensors. Early SCADA networks communicated over radio, modem or dedicated serial lines. Today the trend is to put SCADA data on Ethernet and IP over SONET. For security reasons, SCADA data should be kept on closed LAN/WANs without exposing sensitive data to the open Internet. Real SCADA systems don¶t communicate with Just simple electrical signals, either SCADA data is encoded in protocol format. Older SCADA systems depended on closed proprietary protocols, but today the trend is to open, standard protocols and protocol mediation.

Sensors and control relays are very simple electric devices that can't generate or interpret protocol communication on their own. Therefore the remote telemetry unit (RTU) is needed to provide an interface between the sensors and the SCADA network. The RTU encodes sensor inputs into protocol format and forwards them to the SCADA master in turn, the RTU receives control commands in protocol format from the master and transmits electrical signals to the appropriate control relays.

3. Data Presentation

The only display element in our model SCADA system is the light that comes on when the switch is activated. This obviously won't do on a large scale you can't track a light board of a

thousand separate lights, and you don't want to pay someone simply to watch a light board, either a Real SCADA system reports to human operators over a specialized computer that is variously called a master station, an HMI (Human-Machine Interface) or an HCI (Human-Computer Interface).

The SCADA master station has several different functions. The master continuously monitors all sensors and alerts the operator when there is an alarm that is, when a control factor is operating outside what is defined as its normal operation.The master presents a comprehensive view of the entire managed system, and presents more detail in response to user requests. The master also performs data processing on information gathered from sensors it maintains report logs and summarizes historical trends. An advanced SCADA master can add a great deal of intelligence and automation to your systems management, making your job much easier.

PC based and PLC based automation platforms:

There are two basic automation control platforms available from automation vendors today—PLCs and PC based controllers. A PLC or programmable controller is a digital computer used for automating electromechanical processes, such as the control of machinery on factory assembly lines, amusement rides or lighting fixtures. PLCs come in a wide variety of hardware options and are the most established automation control option in the market today. In contrast, PC based controllers use a software controller installed on an industrial computer. This allows users to integrate high level computer programming or other PC functionality with automation system control.

Today, a PLC is distinguished by a large number of scalable technology functions such as counting, measuring, positioning, closed loop control or CAM control. With a graduated selection, which extends from entry level PLCs to high performance models, there is a suitable solution for every task.

PC based automation solutions allow users to install a software controller on an industrial computer, enabling the integration of high level computer code and PC functionality. These are most effective in situations where the process in question needs closer integration between

automation control and high level PC programs or other PC functionality, such as what is required in a power sub-station.

2.3 Industrial Automation Inflection Points

During a decline, good companies should be looking for revenue growth through significant new technologies that can change the rules of the game. New products that provide an order of magnitude improvement in performance or cost-effectiveness generate an inflection point.

The history of technology-based business is marked by transformations generated by inflection points:

- The introduction of personal computers transformed the business models of the leaders: It led to the decline of IBM (main-frames), and the disappearance of DEC (mini-computers) through acquisition by Compaq, a PC startup.
- The growth of the Internet transformed business in the communications industry. It gave rise to new giants like CISCO (which briefly had the largest market-cap) and AOL (which acquired Time-Warner).

The computer age is over

The technology futurist George Gilder's insists that the computer age is over. The PC revolution, and the silicon technology that triggered it, drove significant growth in the past decade – but these technologies have now become commodities. Gilder suggests that Intel and Microsoft are simply becoming icons of a bygone age – they no longer shape the future.

Intel cannot continue to leverage its power through producing giant chips in multi-billion-dollar factories, because in the future computer intelligence will be disseminated in tiny intelligent chips with wireless connections. The bloated code of Microsoft will not be brought down by another software giant, but will be circumvented by software that is part of every product and appliance. People will not use software – it will simply be part of the things they use.

Of course, the microchip and the computer will still retain their tremendous importance, in ways similar to steel mills and power plants. They have past their peak and now simply become part of the platform that is giving birth to new technologies that are transforming human economies and cultures, faster and more drastically than ever before.

Abundance and Scarcity

In the industrial age, power (steam, coal, oil and electricity) was available in abundance. In the past century, the cost of a kilowatt-hour equivalent dropped from hundreds of dollars to about 5 cents and it continues to decline at about 2 percent per year. De-regulation changes it from being a "scarce commodity" (a paradox of words) that only the power company monopoly could provide and gives it the status of a true commodity. While there may be temporary price surges, de-regulation will inevitably cause eventual pricing to decline to a commodity level.

A typical PC uses about a thousand kW hours per year. The billion computers which are expected to be connected to the Internet over the next five years, together with peripherals and hundreds of billions of embedded chips, will consume as much electricity as the entire US economy does today. So, power, once an "abundance", will become a "scarcity".

During the past 30 years, the cost of a transistor dropped from about $10 to a few millionths of a cent, and continues to decline (Moore's Law) at about 66% a year. Processing MIPS (millions of instructions per second) that cost several millions of dollars sell for less than a buck today. And we utilize that abundance not only in computers and workstations, but also in video games and music synthesizers.

In short, the defining abundances of the past few decades have been silicon and power. People used those abundances to relieve the scarcities. In what Gilder defines as the "macrocosm", they use power to replace horses and slaves, while in the "microcosm" they use silicon intelligence to replace human intelligence.

Defining abundances and scarcities mark every new era. And there is a natural overlap - the successes of one era spur and enable the successes of the next. The plentitude of the agricultural age loosed resources for the industrial revolution, while that in turn served as a platform for the computer revolution. The sons of the industrialists went off to study technology and came back to start new computer or software companies, which now in turn are giving birth to the new era of information connectivity.

The Inflection point

Over the years, people always have felt that scarcity will ultimately prevail over abundance. However, Necessity (the mother of invention) turns scarcity into abundance. Abundances and scarcities play out in a spiral of reciprocity, with each producing its opposite in the cycles of economic advance.

A scarcity finds meaning and value in the future abundance that it causes – and that is the inflection point. This is the where significant growth and wealth is generated for leaders who utilizes knowledge and creativity to manipulate the future abundance while it is still a scarcity.

Industrial automation is becoming a commodity

A few decades ago, industrial automation involved a lot of proprietary knowledge, which generated significant value for the purveyors of that knowledge. Industrial automation products were an essential and proprietary ingredient in factories and process plants. At the turn of the century, a lot of the proprietary content has melted away through rapid and widespread dissemination of the information in the global arena.

Automation knowledge that produces quality goods at low cost has now become a commodity – everyone knows how to do it. In many cases, the western world chased cheap labor in the Far East and educated the locals with their knowledge as part of the project, shortsightedly frittering away the value.

The features and functions of conventional instrumentation and automation products are easily copied and the cost reduces to quality manufacture of commodity products with the lowest overhead. Software is also quickly and easily copied – if not directly, then at least through availability of functional equivalents that can be developed quickly and cheaply in countries like India, which have rapidly become centers of the software universe.

Stop being incremental – look for change

DCS, PLCs, PC-based SCADA and controls drove growth in the past, but they no longer shape the future Now we need new technologies to replace them, products and systems which will provide the same functions – cheaper, faster, better. The old products will simply become part of the platforms that give birth to new technologies that transform the business landscape.

What we ARE good at in the US is new technology. New growth and success will result only for leaders who work with technology that is revolutionary enough to cause significant change. Look for inflection points – the technologies that bring 10X improvements.

Industrial automation inflection points

For industrial automation, several new inflection points will arrive in the next few years. This is where the growth and success will occur, from which new instrumentation and automation leaders will emerge.

MEMS-based Sensors & Actuators: Micro-electromechanical systems that utilize semiconductor fabrication techniques to produce miniature turbines, motors, gears, moving mirrors and sensors.

· **Nanotechnology**: Atomic-scale systems, the next step beyond MEMS. Production with old-style metal bending, grinding and cutting will become obsolete as nanotechnology enables the building of products at the atomic level.

· **Wireless Links:** Tiny, low cost, low power sensors and actuators will be connected with wireless links that are fast, economical and yield big advantages. Tiny is important because they can be scattered around to measure just about everything that you can imagine. Low power, because they won't need to have batteries replaced, and may be solar-powered. Low-cost because the numbers required will be enormous.

· **The Pervasive Internet:** Soon bandwidth will be plentiful enough to connect everything to everything. The old "islands of automation" will disappear.

· Complex **Adaptive Systems (CAS)**: The central control hierarchies of the past will give way to new self-organizing peer-to-peer networks, where intelligence resides directly in the sensors and actuators, eliminating large, complex and ineffective centralized control systems. By these standards, today's PLC and PC-based controls and software will seem ineffective, expensive and even archaic. CAS provides a level of effectives and robustness that is unprecedented, and old deterministic control architectures will disappear.

Chapter 3: Demand Analysis

Even though it's being adopted at a very slow pace, automation is today being used at some level or the other in almost every industry in India. In the Indian electronics industry, there is a good market for sensors, PLCs and PACs. The use of proximity sensors is set to witness growth every year due to the rising sophistication in manufacturing processes. However, the

Indian electronics industry hasn't widely adopted the use of robotics in its production processes.

In the Indian electronics industry, the use of robots is not at the level it is in other countries, even in Asia. In India, only pick and place machines that are fully automated, are widely used. The solar sector has a few companies like Moser Baer that use automation. Another area which requires automation is silicon wafer handling, which is an important part of the solar industry but even here, automation has not been adopted in India

In India, the power and automobile sectors use automation in their processes the most. Smart sensing devices with connectivity to smart inputs/outputs and device information, PLCs, computers for control systems, sensors that bring data to the main system, and automation software are some types of industrial automation in use in India, leading to improvements in productivity and asset maintenance.

3.1 Demand Determinants of the industry:

The Indian automation industry is growing at an annual rate of 20 to 25 percent. With India's gradual integration with the world economy, automation will play an important role in bringing down the costs.

Besides costs, automation will also help increase productivity efficiency, aesthetics and delivery systems. Several international players are considering India as a development hub for automation products.

The Indian automation market has acquired the critical momentum to propel the instrumentation, control and automation industry to a higher growth trajectory. India has the right mix of process industry that provides excellent growth opportunities for the entire spectrum of automation products and systems.

With a gross domestic product (GDP) growth of around 7 percent, India has one of the fastest growing economies in the world, and India is moving steadily on the path of global

integration. Amongst other leading indicators, India is witnessing foreign trade growth, rising domestic consumer demand, infrastructure growth, industrial revival, capacity expansion and a significant pick-up in manufacturing output and the capital goods sector. Realization is fast setting in that India's future cannot depend simply on being the “back office” of the world. Automation has a key role to play in facilitating this quest for being truly world-class and ensuring a “competitive advantage” for the Indian industry.

India, with large investments taking place in process industries, provides strong growth prospects for automation in both the near and long-term. The growing disposable income in the hands of almost a quarter of a billion people is generating a rising demand for a wide range of products. Manufacturers, lured by this opportunity, have created new production facilities in almost all vertical industries.

Because of this cycle of demand, investment and wealth creation, India is emerging as an economic growth engine. Manufacturers' search to gain sustainable competitive advantages leads them to extensively use automation.

3.2 Products:

The following are the list of automation products :

Test & Measurement instruments

General Purpose equipment

Manufacturing

Communications protocol

Mechanical

Analytical Instrumentation & Services

Sensors & Instrumentation

· Sensors

- Smart Sensors
- Emerging Sensors Technologies

Mechanical Power Transmission

- Motors - AC & DC
- Drives - AC & DC
- Belts
- Chain Drivers and Gear Drives
- Fluid Power and Transmission
- Pneumatics and Accessories

Automatic Identification & Security

- Biometric Technologies
- Automatic Identification
- Retail Services
- Security
- RFID & RTLS
- Smart Cards

Electronic Devices

- Board Level Components (active and passive)
- Advanced Packaging
- Design Services
- Supply Chain

- Display Technologies
- Optoelectronics
- MEMS

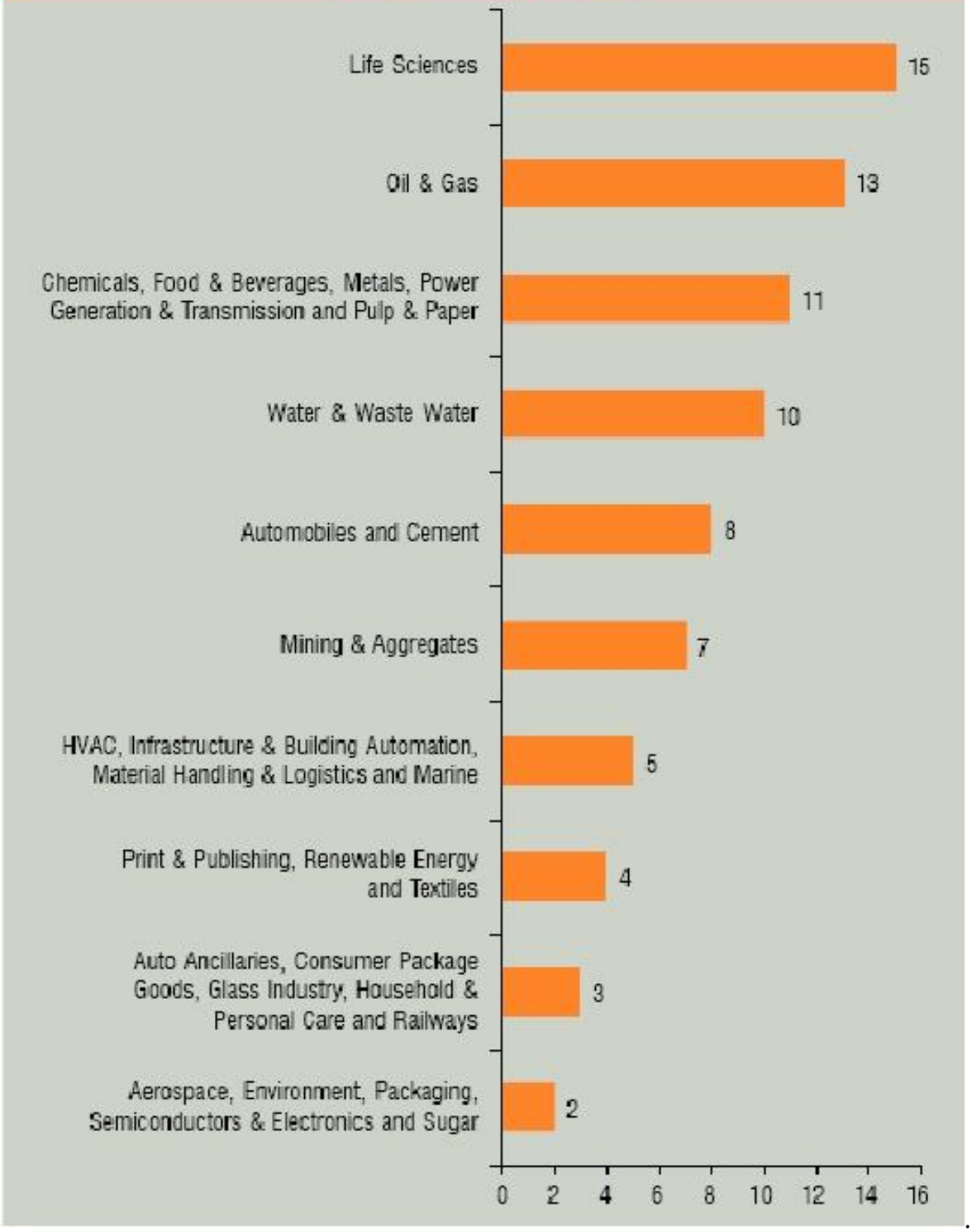
Surface Mount Technologies

- Software Placement Equipment
- Soldering Equipment & Solder Paste
- Screen Printers & Glue Dispensers
- Inspection Equipment
- Cleaning Equipment

3.3 <u>Market Penetration</u>:

As seen in Exhibit 2, water and wastewater treatment sector comes next, followed by automobiles and cement. The sectors with least number of companies serving them are aerospace, environment, packaging, semiconductors and electronics, and sugar

Exhibit 2: Number of Automation Companies Serving Each Industry Vertical



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3.4 Life Cycle Services of Automation Products:

Product life cycle management model:

The life cycle management model divides a product's lifecycle into four phases: active, classic, limited and obsolete. Each phase has different implications for the end user in terms of services and support provided.

In the 'active' phase the end user benefits from warranty options and a full range of life cycle services, spare parts and maintenance materials. This phase ends when the volume production of a particular product ends and the 'classic' phase starts. In addition to offerings available in 'active' phase, end users may migrate to new technology by using upgrade and retrofit solutions providing improved performance and extension of the life cycle.

After the 'classic' phase products enter the 'limited' phase and end users are recommended to start planning a transfer to new technology before product support ceases. Spare part services continue as long as components and materials are available, and throughout the course of time the use of reconditioned parts increases. A product is transferred to the 'obsolete' phase when it is no longer possible to provide life cycle services within reasonable cost, or when ABB can no longer support the product technically, or the old technology is no longer available.

<u>Benefits of product life cycle management:</u>

Product life cycle management maximizes the value of equipment and maintenance investments by:

– ensuring spare part and competence availability throughout the life cycle
– enabling efficient product support & maintenance for improved reliability
– adding functionality to the initial product by following the upgrade path
– providing a smooth transition to new technology at the end of a product's life cycle
– helping the end user to decide when an upgrade, retrofit or replacement is required

Chapter 4: Marketing Strategy Analysis

4.1 Technological Trends in Process Automation

Intelligence, modularity, and remote diagnostics are the trends of the future. Decentralized automation allows distributing intelligent automation components across the plant. Smart pumps are just one example for these units whose electronics are increasingly integrated within the aggregates, thus allowing new forms of communication and interaction. New biotechnological processes, too, represent new challenges for automation, particularly in pharmaceuticals and biotech-based fine chemicals bring new challenges for automation as well. In general, automation technologies will benefit substantially from vertical integration with the information technologies used for management processes. Important growth is emerging at the interface, where both worlds meet – the MES systems. Optimization, statistical quality control, and product tracing/tracking are a few examples. Horizontal integration of core processes with the utilities remains an area of progress and growth as well.

However, automation is not going to explode forever. The manless factory and plant will not materialize yet for many years. Highly automated plants are more flexible than totally automated plants. Moreover, the former have a higher availability as well as lower maintenance and investment costs.

Success Factors for Process Automation Suppliers: Leading suppliers of automation systems and instrumentation will have to focus their product development strategies even more on customer benefit. This leads, above all, to increasingly standardized and modularized products, in particular in view of enhanced communication and smartness features of automation products. The share of “embedded” software continues to grow, the aim being to keep enhancing the functionality of the products, and thus the customer benefit. Product Developers of market leaders should adopt and always live by the philosophy of making their own products obsolete before the competitors do. To maintain market leadership, they practically have to compete with their own success. This philosophy allows, moreover, to identify weak points in a systematic way, and thus to mend them in time. New product and

service concepts should always include the established products as exceptions, so that user firms can continue to use prior investments.

Niche suppliers of automation systems and solutions, on the other hand, should strive to better anticipate the customers' future requirements. There are two ways to achieve this: a systematic bottleneck analysis, and thinking in terms of the needs of the customer's customers. Resulting innovative tendencies in the customer's processes and/or products can help make the supplier's own product and service program more innovative and more future-oriented, and contribute to its optimization. In addition to sophisticated development strategies, service strategies are becoming more and more crucial for longer-term market success. For the project phase, important strategies are: engineering cooperation across borders and time limits, online support for installation and commissioning, and system integration. Innovative service concepts for the operation phase are: online services like remote maintenance and remote support, remote optimization and hotline services as well as intelligently combined service packages. Innovative logistic concepts like Supply Chain Management (SCM) help make automation technology and service suppliers faster, more flexible and more responsive. Finally, systems and solutions for Customer Relationship Management (CRM) will gain in importance over the next few years

4.2 Market Segmentation

Today, industrial automation has two large segments - distributed control systems (DCS) and programmable logic controllers (PLC). The rest of the industry is a scattered array of miscellaneous products and systems, sensors and actuators, all selling to the many different types of industries and applications termed "industrial."

• DCS. Honeywell introduced the original DCS - the TDC 2000 - in 1975. This was considered the fastest growing segment of the automation business - reportedly achieving $100 million in revenues within the first year. Other process controls leaders, like Foxboro, Taylor, Bailey and Yokogawa, quickly followed to make this a sizeable market segment.

The term "distributed" is something of a misnomer, because the system was really large clumps of mini-computers replacing large mainframes in giant central control rooms. Today, DCS has morphed into a variety of different shapes, sizes and form-factors, and this market segment has expanded to several billions of dollars worldwide.

• PLC. The PLC was invented in 1968 by Dick Morley and others working for a consulting company called Bedford Associates, primarily associated with a relatively small Boston-based company called Modicon. From 1977 to the mid-1980s, Gould owned Modicon, and after some shuffling between German AEG and Schneider of France, the company is now owned by Schneider Electric. The development of the PLC was in response to the needs of U.S. automotive manufacturers. The process for updating production facilities for the yearly model changeover was very time consuming and expensive, because electricians needed to individually rewire the hard-wired backplane. The PLC provided "soft" relay-ladder logic programming, easily understood and accomplished by the average electrician. Odo Struger was associated with Dick Morley in the development of the PLC, and Allen-Bradey, the company he was with, quickly rose to prominence through the growth of PLCs in the automobile business. Allen-Bradley, still a privately held company, was sold in 1985 for an estimated $1 billion US in cash to Rockwell International, an aerospace conglomerate. In 2001, Rockwell Automation was formed from the automation segments, and this company is still the market-share leader in North America. Over the past three decades, the PLC has spread throughout the automation industry, and has almost become a commodity. The PLC market segment has grown to several billions of dollars worldwide, and the automotive industry is still one of the largest users.

• Sensors and actuators. The other identifiable segment of industrial automation is sensors and actuators. There are many companies in the segment, each serving specialized niches and a broad array of diversified markets. Perhaps the largest of the sensor companies is Rosemount, founded in 1956 with a focus on temperature sensors for the aerospace industry. In 1966, the com pany diversified its customer base by targeting the process industries with unique differential pressure flow sensors. Rosemount's success captured the attention of the conglomerates and, in August 1976, Emerson Electric acquired the company. Emerson also

acquired Fisher Controls to become a process automation industry leader with products and services in all major categories.

• Software. With the growth of PC-based systems to replace mini-computers, starting in the late 1970s and through the '80s and '90s, several innovative startups developed HMI software for PLCs and industrial I/O. Wonderware, Intellution and a host of others grew quickly, but were inevitably acquired by the larger conglomerates by the time they approached the $20-$50-million plateau. Siebe, a British conglomerate that had already acquired DCS and process controls leader Foxboro, acquired publicly held Wonderware in 1998. Emerson acquired Intellution in 1995, and later sold it to General Electric in 2002. It should be recognized that the 1986 timeframe represented the zenith for several PC software companies; some, like Iconics, with roots in Foxboro, still survive as independents. When growth in PC-based HMI stalled, most software companies moved to broader enterprise systems and sensor-to-boardroom connections.

4.3 Major Players in India

The sales turnover for the financial year 2008-09 has been used here for calculation of market share of the companies. The major players considered here are Siemens India Ltd., ABB India Ltd., L&T EBG, Honeywell Automation India Ltd. Yokogawa India Ltd., and Forbes Marshall. These companies regularly declare the financial reports of their Indian business in public domain. The other companies have been clubbed together as `others' for analysis. Many major global companies such as Invensys, Emerson Process Management, Fanuc, etc., that are present in India do not declare financial results exclusively for their Indian operations. These companies therefore could not be considered here individually.

Looking at the market share, Siemens is the clear winner having captured 17%(Refer Exhibit 3) of the market. Siemens has been very aggressive about bringing out high quality and innovative products. The company had a total sales turnover of $1763 mn during the financial year 2008-09, of which around 40% could be attributed to the automation

business (automation and drives; and industrialsolutions and services divisions). Its focus has been on life sciences and pharmaceuticals, power, cement, glass, metals, mining, water, transp ort andlogistics, building automation, automobiles, railways, pulp and paper, sugar, foodand beverages, and Heating, Ventilating and Air Conditioning (HVAC) industries.

The second biggest company is ABB India Ltd., with 16% market share. The company had a total sales turnover of $1455 mn in the financial year 2008-09, of which the automation business (process automation and automation products divisions) accounted for about 45%. The company is serving industry verticals like oil and gas, power, life sciences, automobiles, mining, metals, chemicals, cement, paper and pulp, printing and publishing, railways, water and wastewater treatment and renewable energy.

The sum of sales turnover of the five major companies which account for over 90%of the market have been considered here for analysis. These companies are ABB Ltd., Siemens Ltd., Honeywell Automation India Ltd., Yokogawa India Ltd., and L&T Ltd. (EBG Division)

As stated earlier, the Indian automation growth story has been very inspiring. Analyzing the sales growth of the Indian automation sector, we can see an average nnual growth rate of 29.6% during the period from 2000 to 2008. The industry's sales, which was at $494 mn during 2000, reached $3714 mn by 2008 (Refer Exhibit 4). The graph closely follows an exponential curve with a coefficient of determination of 0.966

During the period from 2000 to 2003, the growth rate was around 16% annually. This was the time when the world and especially the US economy, was seeing red. As industrial growth was slow in this period, so also was the growth in automation. But comparing it with other industries, this is a growth rate which others don't see even in the best of times. The four years starting from 2004 was a golden period for most developing and developed economies. The growth rate during this period in the automation sector was an eye-popping 44.5%. The rate of industrial production went up to 11.5% in 2006-07 and the manufacturing sector contributed

91% to this(RBI, 2006-07). As automation supports other industrial sectors, the rate of growth of the automation industry paralleled that of industrial growth during this period.

4.4 Geographical Spread

A geographical spread analysis can throw light on what drives the growth of the industry. It can provide pointers about the demand centers and future prospects for growth in different regions. Besides, geographical concentration is also a good indicator of the business enjoying the support and benefit of the local government and the public. Not to say the presence of skilled labor, land and capital in abundance and adequate infrastructure lubricate the industry's operations. Presence in a more industrially stable region also invokes confidence in investors to put their money in the companies operating in that industry.

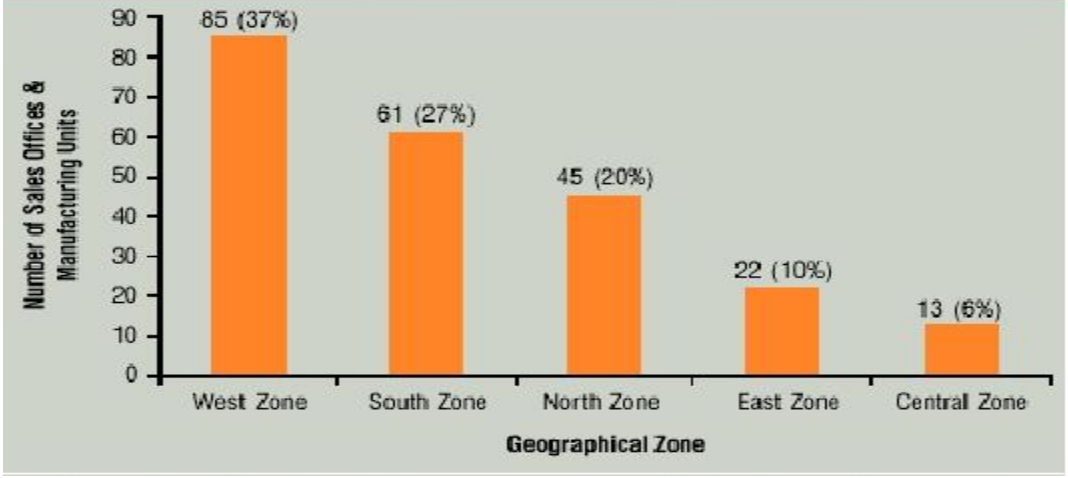
Automation companies make capital goods for other manufacturing companies in several industry verticals. Proximity to these industry verticals becomes logical for their growth. This can be observed in the geographical spread of the sales and manufacturing units of the automation companies (Refer Exhibit 1). Most of the mare in the industrial region of western India, i.e., in the states of Gujarat and Maharashtra. Within this region, Ahmedabad, Vadodara, Mumbai and Pune have the highest concentration of sales offices and manufacturing plants.

The four southern states have the second most number of sales offices andmanufacturing units. This zone has about 27% of all the establishments. Here too, the concentration is more in the major cities of Bangalore, Chennai and Hyderabad. Third in order is the north zone with 20% share. It has a total of 45 sales offices and manufacturing units. The units are concentrated in New Delhi, Chandigarh, Gurgaon and Lucknow. At the fourth and fifth positions are the east and central zones with 10% and 6% share respectively. In the east, the industry is concentrated in Jamshedpur, Kolkata and Bhubaneswar.

It can be very well understood from the geographical spread that the western one, followed by the southern zone, have the highest concentration of automation business. These are also the regions where manufacturing activities have profound concentration. However, in

every zone, there is a belt or cluster where automation activities have flourished. The reason for such cluster formation can be identified from the sectors or industry verticals that avail the automation services. Such segmentation would also help us in understanding which are the major industry verticals accepting automation and reasons thereof.

Exhibit 1: Geographical Distribution of Sales Offices & Manufacturing Units of Major Automation Companies in India



The number of industry verticals in India that use industrial instrumentation and control products are over 25. Of these, life sciences and pharmaceuticals sector are being served by around 15 out of the 20 companies under detailed study (Refer Exhibit 2). The other sector from where automation companies earn most of their business is oil and gas with 13 companies concentrating on this industry. This is followed by power, chemicals, food and beverages, pulp and paper, and metals with 11 companies supplying their products to each of them.

Chapter 5: Financial Analysis

Financial statement analysis is defined as the process of identifying financial strengths and weaknesses of the firm by properly establishing relationship between the items of the balance sheet and the profit and loss account.

There are various methods or techniques that are used in analyzing financial statements, such as comparative statements, schedule of changes in working capital, common size percentages, funds analysis, trend analysis, and ratios analysis.

Financial statements are prepared to meet external reporting obligations and also for decision making purposes. They play a dominant role in setting the framework of managerial decisions. But the information provided in the financial statements is not an end in itself as no meaningful conclusions can be drawn from these statements alone. However, the information provided in the financial statements is of immense use in making decisions through analysis and interpretation of financial statements.

PROFIT MARGIN ANALYSIS

Profit margin, **net margin**, **net profit margin** or **net profit ratio** all refer to a measure of profitability. It is calculated by finding the net profit as a percentage of the revenue.[1]

$$\text{Net profit Margin} = \frac{\text{Net Income}}{\text{Revenue}} \times 100$$

where Net Income = Revenue – Cost

The profit margin is mostly used for internal comparison. It is difficult to accurately compare the net profit ratio for different entities. Individual businesses' operating and financing arrangements vary so much that different entities are bound to have different levels of expenditure, so that comparison of one with another can have little meaning. A low profit margin indicates a low margin of safety: higher risk that a decline in sales will erase profits and result in a net loss, or a negative margin.

Profit margin is an indicator of a company's pricing strategies and how well it controls costs. Differences in competitive strategy and product mix cause the profit margin to vary among different companies.[2]

Net Profit Margin

Net profit margin is a key financial indicator used to asses the profitability of a company. **Net profit margin formula** is:

$$\text{Net Profit Margin} = \frac{\text{Net profit (after taxes)}}{\text{Net Sales}} \times 100$$

Net profit margin measures how much of each dollar earned by the company is translated into profits. A low profit margin indicates a low margin of safety: higher risk that a decline in sales will erase profits and result in a net loss.

Net profit margin provides clues to the company's pricing policies, cost structure and production efficiency. Different strategies and product mix cause the net profit margin to vary among different companies.

Net profit margin is an indicator of how efficient a company is and how well it controls its costs. The higher the margin is, the more effective the company is in converting revenue into actual profit.

Net profit margin is mostly used to compare company's results over time. To compare net profit margin, even between companies in the same industry, might have little meaning. For example, if a company recently took a long-term loan to increase its production capacity, the

net profit margin will significantly be reduced. That does not mean, necessarily, that the company is less efficient than other competitors.

Gross Profit Margin –

A company's cost of sales, or cost of goods sold, represents the expense related to labor, raw materials and manufacturing overhead involved in its production process. This expense is deducted from the company's net sales/revenue, which results in a company's first level of profit, or gross profit. The gross profit margin is used to analyze how efficiently a company is using its raw materials, labor and manufacturing-related fixed assets to generate profits. A higher margin percentage is a favorable profit indicator.

Industry characteristics of raw material costs, particularly as these relate to the stability or lack thereof, have a major effect on a company's gross margin. Generally, management cannot exercise complete control over such costs. Companies without a production process (ex., retailers and service businesses) don't have a cost of sales exactly. In these instances, the expense is recorded as a "cost of merchandise" and a "cost of services", respectively. With this type of company, the gross profit margin does not carry the same weight as a producer-type company.

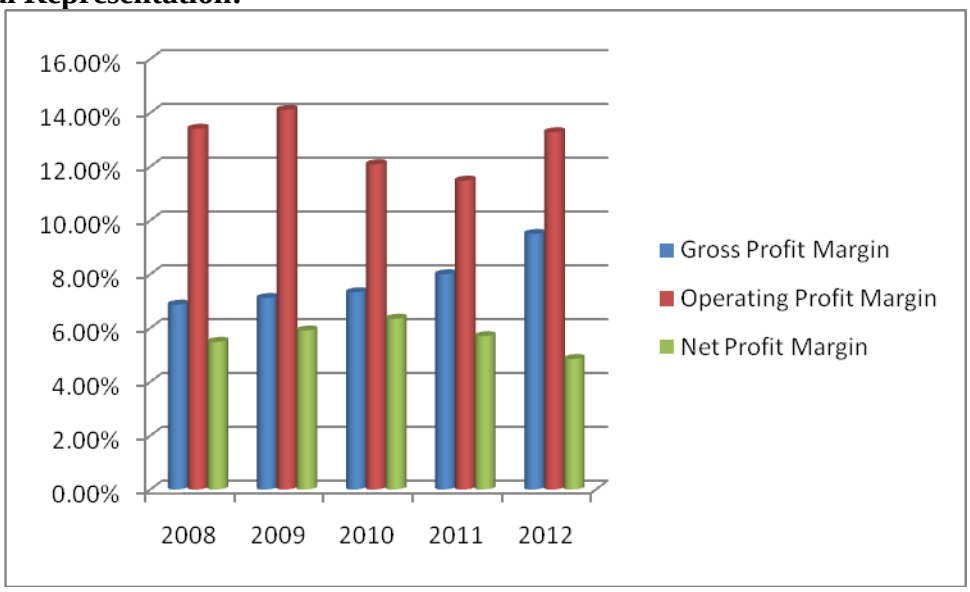
Operating Profit Margin –

By subtracting selling, general and administrative (SG&A), or operating, expenses from a company's gross profit number, we get operating income. Management has much more control over operating expenses than its cost of sales outlays. Thus, investors need to scrutinize the operating profit margin carefully. Positive and negative trends in this ratio are, for the most part, directly attributable to management decisions.

A company's operating income figure is often the preferred metric (deemed to be more reliable) of investment analysts, versus its net income figure, for making inter-company comparisons and financial projections.

Profit Margin(in percentage)					
Year	**2008**	**2009**	**2010**	**2011**	**2012**
No. of Companies	16	18	20	21	23
Gross Profit Margin	6.87%	7.12%	7.33%	8.00%	9.50%
Operating Profit Margin	13.41%	14.11%	12.09%	11.48%	13.28%
Net Profit Margin	5.49%	5.91%	6.35%	5.70%	4.85%

Graphical Representation:



Analysis:

Gross profit margin ratio shows how efficiently a business is using its materials and labour in the production process and gives an indication of the pricing, cost structure, and production efficiency of your business. The higher the gross profit margin ratio the better.

A high net profit margin ratio demonstrates how effective your business is at converting sales into profit. It may mean that you are capitalizing on some competitive advantage that can provide your business with extra capacity and flexibility during the hard times.

Higher value of operating margin ratio is favorable which indicates that more proportion of revenue is converted to operating income. An increase in operating margin ratio overtime

means that the profitability is improving. It is also important to compare the gross margin ratio of a business to the average gross profit margin of the industry. In general, a business which is more efficient is controlling its overall costs will have higher operating margin ratio.

Profitability ratios:

Profitability ratios measure a company's ability to generate earnings relative to sales, assets and equity. These ratios assess the ability of a company to generate earnings, profits and cash flows relative to relative to some metric, often the amount of money invested. They highlight how effectively the profitability of a company is being managed.

Return on asset

This ratio indicates how profitable a company is relative to its total assets. The return on assets (ROA) ratio illustrates how well management is employing the company's total assets to make a profit. The higher the return, the more efficient management is in utilizing its asset base. The ROA ratio is calculated by comparing net income to average total assets, and is expressed as a percentage.

Formula:

$$\text{Return on Assets} = \frac{\text{Net Income}}{\text{Average Total Assets}}$$

Return on equity

This ratio indicates how profitable a company is by comparing its net income to its average shareholders' equity. The return on equity ratio (ROE) measures how much the shareholders earned for their investment in the company. The higher the ratio percentage, the more efficient management is in utilizing its equity base and the better return is to investors.

Formula:

$$\text{Return on Equity} = \frac{\text{Net Income}}{\text{Average Shareholders' Equity}}$$

ROCE

The return on capital employed (ROCE) ratio, expressed as a percentage, complements the return on equity (ROE) ratio by adding a company's debt liabilities, or funded debt, to equity to reflect a company's total "capital employed". This measure narrows the focus to gain a better understanding of a company's ability to generate returns from its available capital base.

By comparing net income to the sum of a company's debt and equity capital, investors can get a clear picture of how the use of leverage impacts a company's profitability. Financial analysts consider the ROCE measurement to be a more comprehensive profitability indicator because it gauges management's ability to generate earnings from a company's total pool of capital.

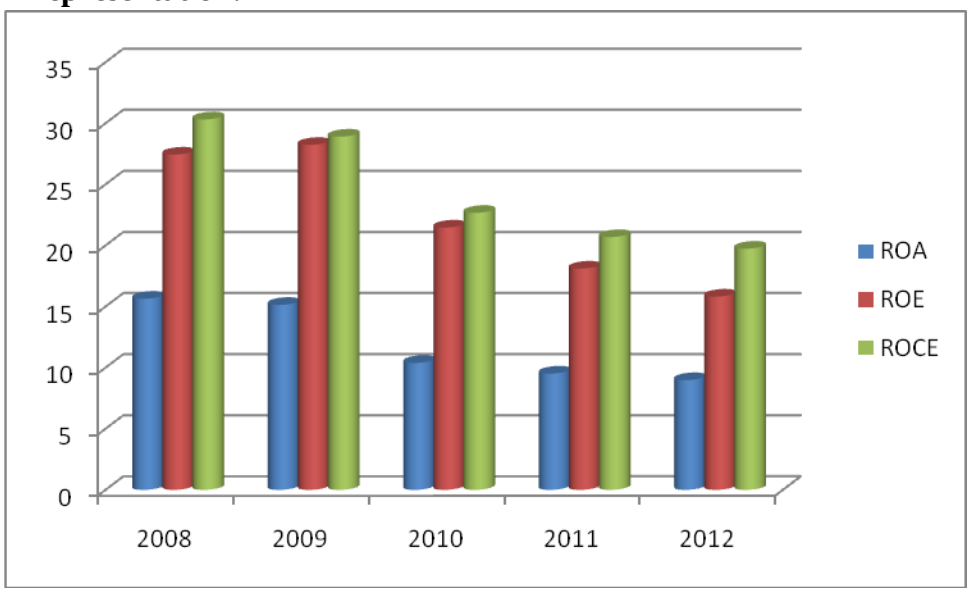
Formula:

$$\text{Return on Capital Employed (ROCE)} = \frac{\text{Net Income}}{\text{Capital Employed}}$$

$$\text{Capital Employed} = \text{Average Debt Liabilites} + \text{Average Shareholders' Equity}$$

Profitability Analysis – Investment Based(in percentage)					
Year	**2008**	**2009**	**2010**	**2011**	**2012**
ROA	15.64	15.14	10.39	9.52	8.98
ROE	27.44	28.23	21.47	18.11	15.82
ROCE	30.32	28.91	22.67	20.69	19.74

Graphical Representation:



Analysis

Return on assets indicates the number of cents earned on each dollar of assets. Thus higher values of return on assets show that business is more profitable. This ratio should be only used to compare companies in the same industry. The reason for this is that companies in some industries are most asset-insensitive i.e. they need expensive plant and equipment to generate income compared to others. Their ROA will naturally be lower than the ROA of companies which are low asset-insensitive. An increasing trend of ROA indicates that the profitability of the company is improving. Conversely, a decreasing trend means that profitability is deteriorating.

Return on equity is an important measure of the profitability of a company. Higher values are generally favorable meaning that the company is efficient in generating income on new investment. Investors should compare the ROE of different companies and also check the trend in ROE over time. However, relying solely on ROE for investment decisions is not safe. It can be artificially influenced by the management, for example, when debt financing is used to reduce share capital there will be an increase in ROE even if income remains constant. But the Automation industry has been showing declining ROE from 27.44 percent in 2008 to 15.82 percent currently.

A higher value of return on capital employed is favorable indicating that the company generates more earnings per dollar of capital employed. A lower value of ROCE indicates

lower profitability. A company having less assets but same profit as its competitors will have higher value of return on capital employed and thus higher profitability.

'Earnings Per Share - EPS'

The portion of a company's profit allocated to each outstanding share of common stock. Earnings per share serves as an indicator of a company's profitability.

Calculated as:

$$= \frac{\text{Net Income - Dividends on Preferred Stock}}{\text{Average Outstanding Shares}}$$

When calculating, it is more accurate to use a weighted average number of shares outstanding over the reporting term, because the number of shares outstanding can change over time. However, data sources sometimes simplify the calculation by using the number of shares outstanding at the end of the period.

Diluted EPS expands on basic EPS by including the shares of convertibles or warrants outstanding in the outstanding shares number.

'Price-Earnings Ratio - P/E Ratio'

A valuation ratio of a company's current share price compared to its per-share earnings.

Calculated as:

Market Value per Share

Earnings per Share (EPS)

For example, if a company is currently trading at $43 a share and earnings over the last 12 months were $1.95 per share, the P/E ratio for the stock would be 22.05 ($43/$1.95).

EPS is usually from the last four quarters (trailing P/E), but sometimes it can be taken from the estimates of earnings expected in the next four quarters (projected or forward P/E). A third

variation uses the sum of the last two actual quarters and the estimates of the next two quarters.

'Dividend Per Share - DPS'

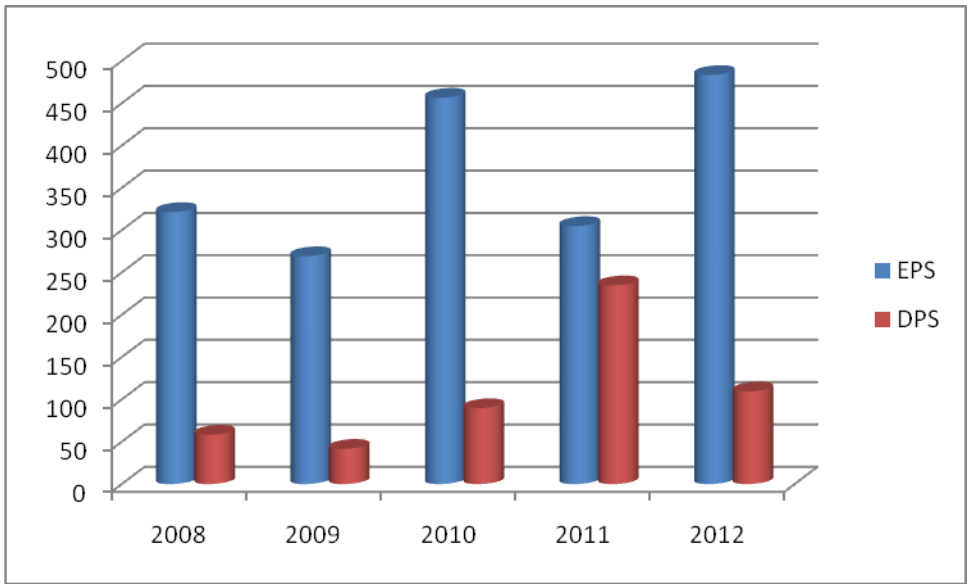
The the sum of declared dividends for every ordinary share issued. Dividend per share (DPS) is the total dividends paid out over an entire year (including interim dividends but not including special dividends) divided by the number of outstanding ordinary shares issued.

DPS can be calculated by using the following formula:

$$DPS = \frac{D - SD}{S}$$

D - Sum of dividends over a period (usually 1 year)
SD - Special, one time dividends
S - Shares outstanding for the period

Graphical Representation:



Profitability Analysis – Market driven(in percentage)					
Year	**2008**	**2009**	**2010**	**2011**	**2012**
EPS	321.45	269.28	456.55	304.87	483.38
DPS	58.36	41.68	89.71	234.94	109.53

Analysis

For financial analysis justified P/E ratio is calculated using dividend discount method.

If the justified P/E calculated using dividend discount analysis is higher than the current P/E ratio the share is undervalued and should be purchased. If the justified P/E is lower than P/E ratio the share is overvalued and should be sold.

The EPS ratio calculation involves dividing a company's net income minus dividends paid on preferred stock by the average number of outstanding shares of common stock for the evaluation period. The income statement shows net income and paid preferred dividend expense, while total shares outstanding is found on the statement of stockholder's equity. The calculation becomes more complex when a company has stock options or convertible securities outstanding. Exercising or converting these instruments may cause dilution of earnings because of a declining earnings per share. EPS may also be calculated assuming all potential exercises and conversion have taken place.

The dividend per share is defined as the total of declared dividends for each share of stock issued. Dividends are essentially profit-sharing mechanisms allowing the distribution of company profits to the shareholders who actually own the company. Generally announced on a quarterly basis, the dividend per share is important both to shareholders who expect to realize financial gain from dividends paid and to financial analysts and investment brokers who often use the dividend per share as an indicator of a company’s overall financial profitability. Although **dividends per share** are typically announced quarterly, investors and analysts rely on the **annual dividend per share** figure as a more reliable indicator of economic health.

4 LEVERAGE ANALYSIS

Leverage ratios show the proportions of debt and equity in financing the firm's assets. It is calculated to measure the financial risk and the firm's ability of using debt to shareholders' advantage.

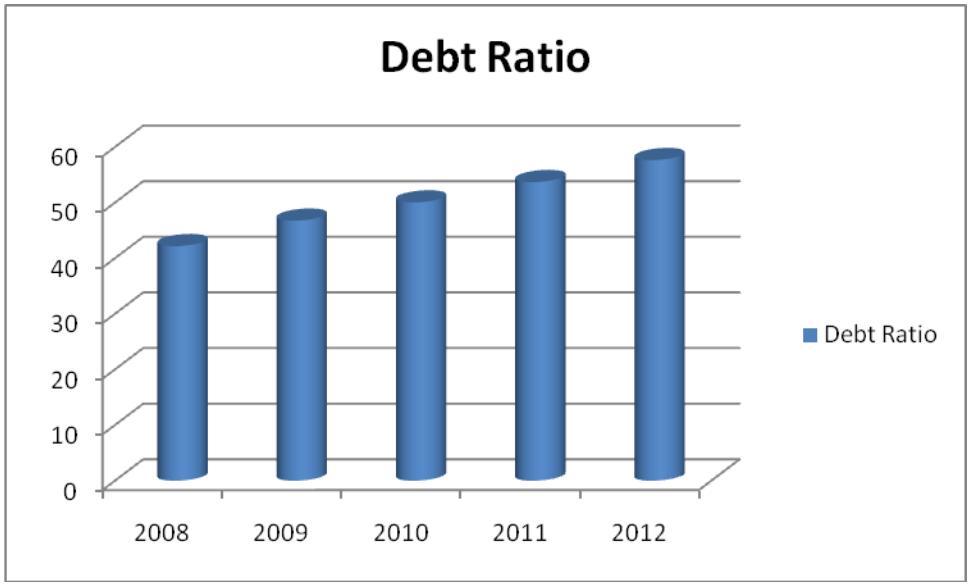
5.4.1 TOTAL DEBT RATIO

Several debt ratios may be used to analyze the long-term solvency of a firm. The firm may be interested in knowing the proportion of the interest-bearing debt (also called funded debt) in the capital structure. It may, therefore, compute debt ratio by dividing total debt (TD) by capital employed (CE) or total net assets (NA). Total debt will include short- and long-term borrowings from financial institutions, debentures/bonds, deferred payment arrangements for buying capital equipments, and bank borrowing, public deposits and any other interest-bearing loan. Capital employed will include total debt and net worth (NW).

$$\mathbf{TotalDebtRatio} = \frac{\mathbf{TotalDebt}}{\mathbf{CapitalEmployed}}$$

Debt Ratio(in percentage) As on 18/10/2012					
Year	**2008**	**2009**	**2010**	**2011**	**2012**
Debt Ratio	42.19	46.76	50.05	53.71	57.66

Graphical Representation:



Analysis

The debt composition of the total capital employed is fluctuating. It has increased by around 15 percent from 42.19 percent to 57.66 percent from 2012. This high debt can be seen as they have insufficient capital to fund their working or that the industry is utilizing this debt to expand.

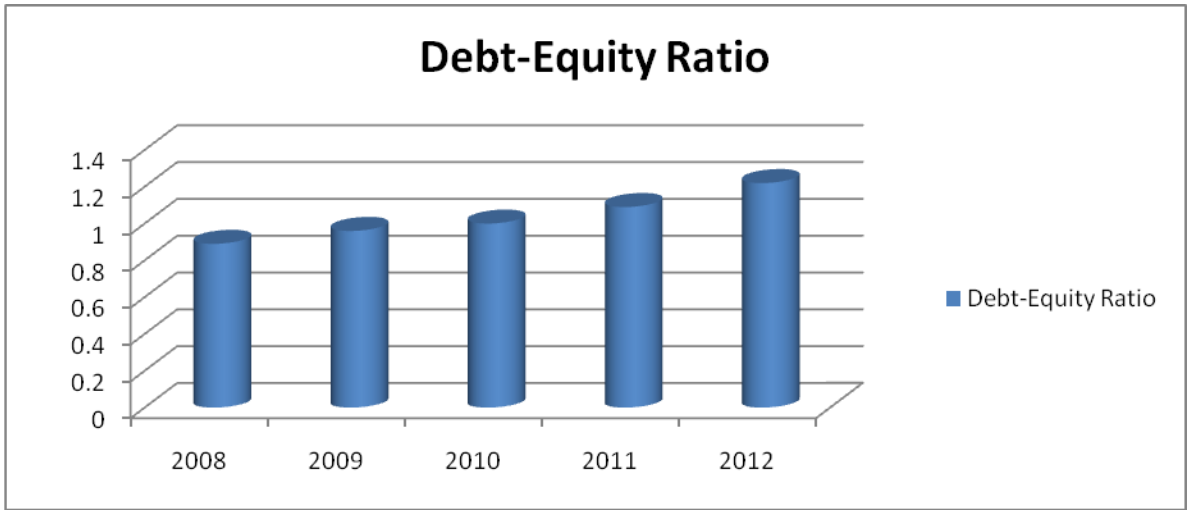
2 DEBT –EQUITY RATIO

The relationship describing the lenders' contribution for each rupee of the owners' contribution is called debt-equity ratio. Debt to equity ratio indicates the proportionate claims of owners and the outsiders against the firm's assets. The purpose is to get an idea of the cushion available to outsiders on the liquidation of the firm. The debt-equity ratio is another leverage ratio that compares a company's total liabilities to its total shareholders' equity. This is a measurement of how much suppliers, lenders, creditors and obligors have committed to the company versus what the shareholders have committed.

$$\textbf{Debt} - \textbf{Equity Ratio} = \frac{\textbf{Total Debt}}{\textbf{Net Worth}}$$

Debt-Equity Ratio					
Year	**2008**	**2009**	**2010**	**2011**	**2012**
Debt-Equity Ratio	0.89	0.96	1.00	1.09	1.22

Graphical Representation:



Analysis

A ratio of 1:1 is usually considered to be satisfactory ratio although there cannot be rule of thumb or standard norm for all types of businesses. But again specific industries tend to exhibit specific values of debt to equity ratios. Capital-intensive industries like construction equipment industry exhibit a debt to equity ratio which is greater than two. The trend in this industry is showing that it is becoming more dependent on debt. Between debt and equity, debt is more risky from the firm's point of view as the firm has legal obligation to pay interest to debt holders irrespective of the profits made or losses incurred by the firm.

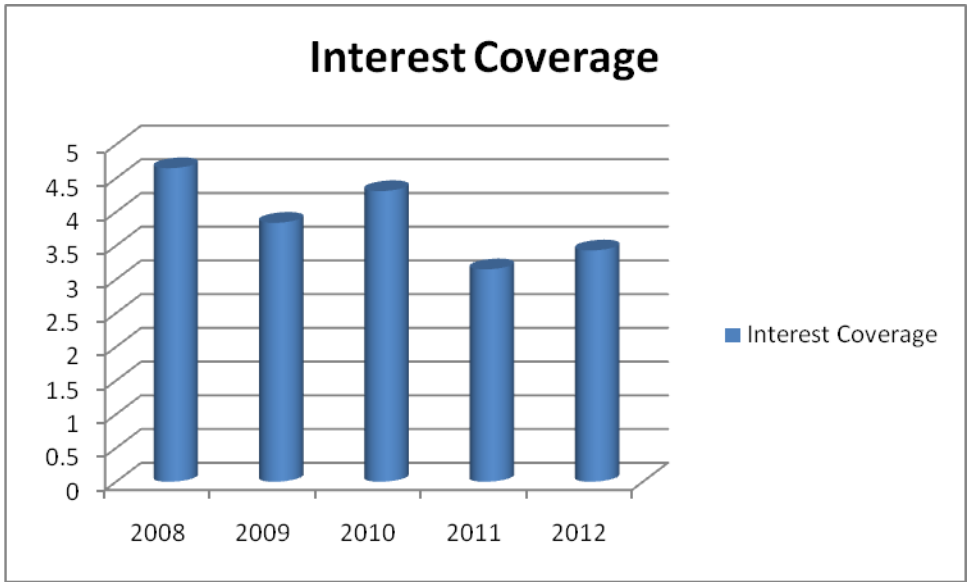
INTEREST COVERAGE RATIO

The interest coverage ratio is used to test the firm's debt-servicing capacity. It shows the number of time the interest charges are covered by funds that are ordinarily available for their payment. This ratio indicates the extent to which earnings may fall without causing any embarrassment to the firm regarding the payment of the interest charges.

$$\text{Interest coverage} = \frac{\text{EBIT}}{\text{Interest}}$$

Interest Coverage Ratio					
year	**2008**	**2009**	**2010**	**2011**	**2012**
Interest Coverage	4.65	3.84	4.31	3.15	3.43

Graphical Representation:



Analysis

A higher ratio is desirable; but too high a ratio indicates that the firm is very conservative in using debt, and that it is not using credit to the best advantage of shareholders. A lower ratio indicates excessive use of debt or inefficient operations.

'DuPont Analysis'

A method of performance measurement that was started by the DuPont Corporation in the 1920s. With this method, assets are measured at their gross book value rather than at net book value in order to produce a higher return on equity (ROE). It is also known as "DuPont identity".

DuPont analysis tells us that ROE is affected by three things:

- Operating efficiency, which is measured by profit margin
- Asset use efficiency, which is measured by total asset turnover
- Financial leverage, which is measured by the equity multiplier

According to DuPont analysis:

Return on Equity = Net Profit Margin × Asset Turnover × Financial Leverage

$$\text{Return on Equity} = \frac{\text{Net Income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Total Assets}} \times \frac{\text{Total Assets}}{\text{Total Equity}}$$

Year	**2008**	**2009**	**2010**	**2011**	**2012**
Sales/ NA	2.15	1.81	1.88	1.63	1.55
GP/Sales	8.55%	10.76%	9.43%	8.71%	7.54%
EBIT/GP	1.41	1.21	1.53	1.48	1.54
PAT/EBIT	0.4921	0.4533	0.4229	0.3586	0.3940
NA/NW	1.95	1.98	2.00	2.08	2.22
ROE	24.45%	27.19%	20.59%	16.45%	15.14%

Analysis

DuPont equation provides a broader picture of the return the company is earning on its equity. It tells where a company's strength lies and where there is a room for improvement.

DuPont equation could be further extended by breaking up net profit margin into EBIT margin, tax burden and interest burden. This five-factor analysis provides an even deeper insight.

ROE = EBIT Margin × Interest Burden × Tax Burden × Asset Turnover × Financial Leverage

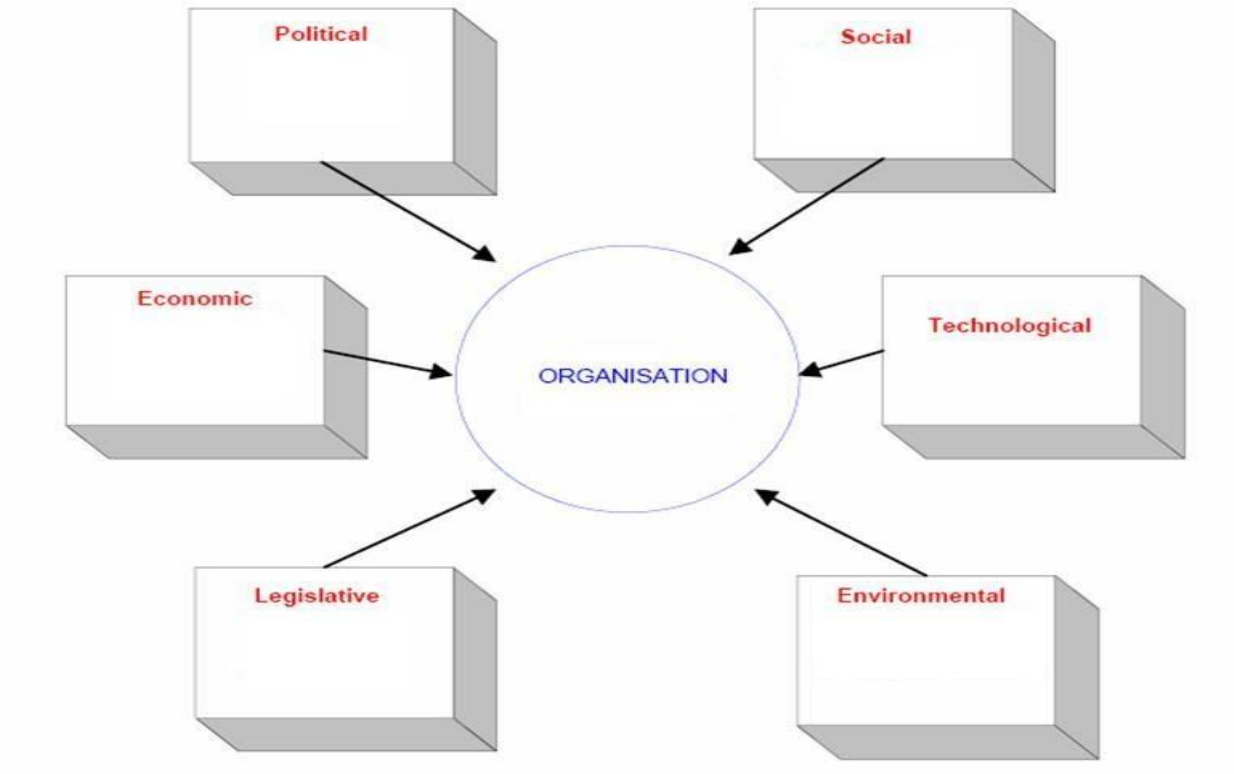
Chapter 6: Industry Analysis

6.1 PESTEL Analysis

A PESTLE analysis, sometimes referred to as a PEST Analysis, is a useful tool for understanding the industry situation as a whole, and is often used in conjunction with a SWOT analysis to assess the situation of an individual business.

A PESTLE Analysis is one of the most important frameworks of macro-environmental scanning, framework which comprises the most important factors used in environmental scanning, as part of advanced strategic management.

Throughout the last few years, the acronym PESTLE has suffered a number of changes, but PESTLE seems to be the most commonly spread and almost unanimously accepted "concept".



PESTLE stands for “Political, Economic, Sociological, Technological, Legal and Environmental” factors. The questions to ask yourself are:

- What are the key political factors likely to affect the industry?
- What are the important economic factors?
- What cultural aspects are most important?
- What technological innovations are likely to occur?
- What current and impending legislation may affect the industry?
- What are the environmental considerations?

Each and every category of factors is of crucial importance to advanced strategic management, and the PESTLE analysis in itself is definitely a must for any business or company, regardless of its industry. It is true that the importance of each category of factors will always vary from business to business and from company to company, but nonetheless PESTLE remains a mandatory analysis technique that is usually a part of the larger and more comprehensive SWOT analysis.

PESTLE helps a company determine exactly how various types and categories of factors influence its “well-being”. As aforementioned, the same factors will influence different companies in different ways. For instance, an online business will be less concerned about environmental factors while a waste management company will have to pay extra attention to environmental factors.

To further understand what PESTLE is and how it can be used, it is very important that you know a thing or two about each individual category of factors. The below descriptions should help you gain a better understanding of each factor and of just how powerful and effective a PESTLE analysis can be for a business.

- **Political factors** represent the way and the extent to which a government influences the economy and a certain business. Political factors are represented by specific areas, such as labour law, tax policy, tariffs, trade restrictions and even environmental law.

- **Economic factors** refer to areas unique to economy and directly influenced by economy or comprised by economy, areas such as inflation rate, interest rate, economic growth or exchange rates. All these areas can greatly influence a business or company, which makes them an extremely important part of the PESTLE analysis.

- **Social factors** mainly refer to demographic factors, which comprise factors like population growth rate, cultural aspects, age distribution and health consciousness.

- **Technological factors** refer to automation, incentives, the rate of technological change and R&D activity. These factors greatly influence other areas or aspects, including the minimum efficient production level, quality, costs and even outsourcing decisions.

- **Legal factors** refer to all the laws directly connected to a business/company and its area of activity, including consumer law, antitrust law, discrimination law and health and safety law.

- **Environmental factors** refer to all the factors directly related, influenced or determined by the surrounding environment. This includes, but is not limited to weather, climate, geographical position, climate change and even insurance. Environmental factors are crucial to industries such as farming or tourism and can greatly influence a company's way to operate or even the products it offers.

The PESTLE analysis consists in carefully determining all these factors and finding out exactly in what way and to what extent these factors influence a certain company. The PESTLE analysis provides the company with crucial information and this is why it is a mandatory analysis.

Economic & Technological factors:

The Indian markets are slowly beginning to feel the stimulus for the instrumentation, control and automation industry. Today, the growing awareness among the Indian consumer has ensured that process industry has the right mix of technologies that can beget the growth opportunities, which the industry has been eyeing and seeking for a long time now. Indian automation is advancing at a fast pace, yet it is one area that can never be achieved and admired – it is something that needs a constant innovation and identification of trends in technology and the innovations that thrust the implementation of automation in other countries – as it is a development that will always impact the future of automation in India. While everything may seem perfect at the face of it, India still has much to worry about the state of innovation in the automation industry. Like always, it is really in the hands of the decision-makers in each industry to bring home the best that technology has to offer.

Having comprehended the importance of automation for the success and progress of the industrial set-up and thereby the country, today many companies are making large investments in bringing the latest technologies for the processes. Today, the manufacturers have also discovered the opportunity that awaits them in almost all production facilities in vertical industries, thanks to the awareness of the customers about the latest technology innovations. The demand of technology and the subsequent complying by the manufacturers has put India on a path of economic growth. Today, the competition among manufacturers has created many advantages for the customers as far as the use of automation is concerned.

India, as one of the world's fastest growing economies, has to technologies at a rather quick pace. India's growing foreign trade, rising internal consumer demand, growth in infrastructure growth as well as the revival from the economic slowdown has only given the entire financial set up a new lease of life. India has now realized the importance of developing its own strength with automation instead of being the smaller ally of the world. Automation is the answer to India's pursuit for being a world-class industrial competitor. This is a feeling that is

contagiously spreading across all industry verticals and everyone wants to use automation from a student library to hospitals to manufacturing plants.

India, along with China is fast gaining much control in the field of automation, which until now, the USA and Western Europe enjoyed. India's reliance on automation for power plants, refineries, chemical and metal production is increasingly growing. Today, India like the highly industrialized countries, is looking at improving the quality of its products as well as give consumers much choice because even the present day consumer is very market-conscious and understands his requirements better than before. Automation is also needed to enhance the process safety and plant availability as well as efficiently use the limited energy resources and try to be as sustainable as possible. Automation is a single solution to achieving quality as well as the environmental balance. Apart from this, the growing interface, optimization, quality control and product tracking are a few advantages that India has now estimated to receive from higher automation controls.

Higher accuracy and better interfaces are the trends that can help India much along with the intelligence and remote diagnostics that automation processes today bring along. While decentralized automation which enables intelligent dispersing of automation components across the plant like smart pumps has become common in many plants in India, allowing a much improved level of interaction and communication within a plant.

Recently, automation is gaining importance even in the medium and small units, unlike earlier when its focus area was restricted to large manufacturing industries. Smaller industries and manufacturing units are beginning to see automation in a new light because of their low productivity. With the automation equipment becoming more usable and affordable, the cost-benefit works in favor of these small industries – in turn, driving automation further. Today, the Indian automation industry is estimated at about Rs 10,000-crore and is only growing at a fast pace – as much as 25 per cent per annum. This is not just a good graph, but also an indication that in the years to come automation will see only more positive acceptance in industrial processes. India's greatest advantage lies in the fact that it has no pressure of choosing technologies like the Western countries. Fortunately, while every one keeps an eye

on industrial progresses in India, we are not constantly watched and scrutinized like the US or Germany, thus giving us the freedom to choose whatever technology we think best for our set-up, most automation products have become commodities that are available in abundance, thus equally vulnerable to price reductions and stiff competition. Recession makes the competition more brutal with the basic features and functions of PLC and DCS systems being replicated to bring down costs and make it available to low budget businesses. It is also making the software easily imitable, through functional equivalents.

An expert who has been implementing projects for the most efficient plants across the country believes that choosing the right automation combinations facilitates integration of manufacturing processes with business systems. It reduces the dependency on goods that are imported from industrialized countries, instead making India produce the best quality within the reach of the users and of course at a much affordable price. For instance, manufacturing of something as important as steel can be so easy and abundant by putting in place the right automation technologies that it will drastically reduce the need to import the raw material for manufacturing so many commodities, including automobiles. Recently, India needs automation in almost every industry. Every industry needs a boost as only high-cost plants are automated in the present day scenario. Technologically oriented industries such as power plants, stones and earth industries, glass and ceramics, iron, steel, non-ferrous metal production, rolling mills for steel and aluminum sheets, chemical and pharmaceutical, petro, pulp, cardboard and paper , the food, mining, oil and gas and industries relating to the environmental protection such as drinking water, sewage plants, incinerating plants and so on are all included in the purview of process industries, yet, each of these industries consists of at least one part of an entire process requires advanced automation, where it is lagging.

Though it is impossible to pinpoint one industry, automation should be aimed at improving the public life at large. Public sector industries that directly affect the life of the people, such as power, water and transportation need to be given a boost. Wireless, including WWAN, e.g. GPRS, and WLAN, e.g. Wi-Fi, and upcoming Wi-Max are India’s future technologies. Understanding this need for automation in the power sector, the government has in the 2010 Union budget, set down a plan to creating and harness alternative sources of power using

automation. Automation must be rightly implemented in this sector if India has to achieve its goals to its fullest potential ,the technology related to harnessing solar power can be categorized into several key areas related to materials (polysilicon), cells, modules and the remaining portion normally referred to as balance-of-systems (BOS). In terms of manufacturing technology for cells and modules, India is on par with other countries as evident from exports to Germany, US and other markets (this is largely due to the fact that the Indian industry uses manufacturing equipment from global companies). There is a difference, though in that the degree of automation in India is broadly speaking, less compared to Germany and the US. As the volume of production goes up and the drive for higher cost efficiency continues, we anticipate that the gap in automation will be bridged in the coming year. India faces issues related to infrastructure, thus shifting more focus on the industrial design. For example, the GPRS stability is relatively lower than other countries, i.e. the auto-reconnect and auto-recovery mechanism is more critical in India.

On the other hand, due to the weather (temperature and humidity), dust and power supply frequencies are too unstable, which the product design should regard. As the Indian industry has adopted enterprise solutions for business processes; it should also consider collaborative systems to bring out the best business value from these technologies. Several companies adapt to Enterprise Resource Planning (ERP) for business processes, but falter at the lack of basic plant automation and it leads no where. This despite the fact that India's manufacturing sector has is a crucial part of the country's progress, heavily dependent on the level to which one can adopt and implement automation. Automation in India has come a long way since the early 1990s and its place in growing the country's GDP is crucial as India must have a strong manufacturing base that can see its economy rise – and automation is an integral part of that process. That it is the responsibility of the suppliers of automation systems and instrumentation to focus their product development strategies even more on customer benefit and also educate them about the latest possible ways to most efficiently implement then. Recently it is important to achieve a standardized and modularized plant enabled with enhanced communication and smartness. It is imperative that manufacturers decide to better their own product development skills instead of leaving it to their competitors.

This will also allow the suppliers of automation solutions to be constantly prepared to predict the future technology trend. System integration and innovative service concepts for operations that rely on online remote maintenance and remote support, remote optimization and hotline services as well as intelligently combined service packages are today of utmost importance. Innovative logistic concepts like Supply Chain Management (SCM) also enhance technology by making it faster, more flexible and responsive. Customer Relationship Management (CRM) too is a concept that will be a reality in the future. While lack of skill to implement most technology seems to be one of India's biggest concerns, experts believe that the scenario is not as bleak as before. The global market for process automation has grown to USD 94.2 billion in 2010. The growth rate for the decade is estimated to be at 4.4%. And while many have always thought US as being the dominating force for technology, India is fast catching up, aiming to achieve automated factories and processes.

Social Factors:

Impact on the individual*:* Nearly all industrial installations of automation, and in particular robotics, involve a replacement of human labour by an automated system. Therefore, one of the direct effects of automation in factory operations is the dislocation of human labour from the workplace. The long-term effects of automation on employment and unemployment rates are debatable. Most studies in this area have been controversial and inconclusive. Workers have indeed lost jobs through automation, but population increases and consumer demand for the products of automation have compensated for these losses. Labour unions have argued, and many companies have adopted the policy, that workers displaced by automation should be retrained for other positions, perhaps increasing their skill levels in the process. This argument succeeds so long as the company and the economy in general are growing at a rate fast enough to create new positions as the jobs replaced by automation are lost.

Of particular concern for many labour specialists is the impact of industrial robots on the work force, since robot installations involve a direct substitution of machines for humans, sometimes at a ratio of two to three humans per robot. The opposing argument within the United States is that robots can increase productivity in American factories, thereby making these firms more competitive and ensuring that jobs are not lost to overseas companies. The

effect of robotics on labour has been relatively minor, because the number of robots in the United States is small compared with the number of human workers. As of the early 1990s, there were fewer than 100,000 robots installed in American factories, compared with a total work force of more than 100 million persons, about 20 million of whom work in factories.

Automation affects not only the number of workers in factories but also the type of work that is done. The automated factory is oriented toward the use of computer systems and sophisticated programmable machines rather than manual labour. Greater emphasis is placed on knowledge-based work and technical skill rather than physical work. The types of jobs found in modern factories include more machine maintenance, improved scheduling and process optimization, systems analysis, and computer programming and operation. Consequently, workers in automated facilities must be technologically proficient to perform these jobs. Professional and semiprofessional positions, as well as traditional labour jobs, are affected by this shift in emphasis toward factory automation.

Impact on the society*:* Besides affecting individual workers, automation has an impact on society in general. Productivity is a fundamental economic issue that is influenced by automation. The productivity of a process is traditionally defined as the ratio of output units to the units of labour input. A properly justified automation project will increase productivity owing to increases in production rate and reductions in labour content. Over the years, productivity gains have led to reduced prices for products and increased prosperity for society.

A number of issues related to education and training have been raised by the increased use of automation, robotics, computer systems, and related technologies. As automation has increased, there has developed a shortage of technically trained personnel to implement these technologies competently. This shortage has had a direct influence on the rate at which automated systems can be introduced. The shortage of skilled staffing in automation technologies raises the need for vocational and technical training to develop the required work-force skills. Unfortunately the educational system is also in need of technically qualified instructors to teach these subjects, and the laboratory equipment available in schools does not always represent the state-of-the-art technology typically used in industry.

Influence of Standardization and Legislation

To meet legal requirements and to ensure quality and compatibility, norms and standards are adopted to define product features. In particular, the Indian guidelines and their national implementation, as well as international and national regulations play an important role. For example, the ROHS guideline called for a ban on products containing lead substances which led to the introduction of lead-free soldering processes and the use of new electronic components. As a result, products had to be partially adapted (re-design) or taken off the market entirely as previously used components, such as integrated circuits and processors, were no longer available.

When norms and standards change as a result of technological developments, producers are forced to adapt their automation products and their components accordingly. It is important to note that a particular automation product is usually not affected by just one standard. In fact, in most cases, country-, industry- and application-specific norms and regulations are applicable when launching a product.

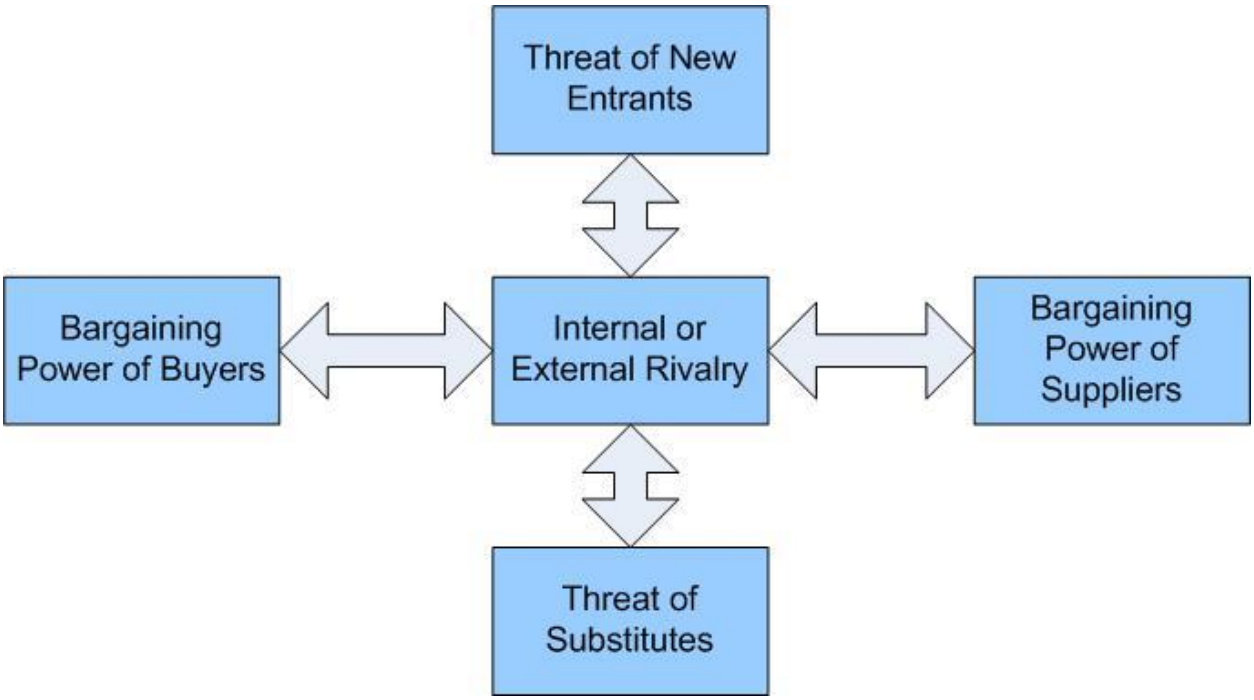
Typical examples include the European CE marking and special certification requirements such as the CCC (China), the UL (USA) and the CSA (Canada). Additional industry and/or application-specific regulations define special application requirements, for example in the food industry or in areas with explosion risks. All of these norms and regulations may be changed due to new country-specific legislation or new industry-specific requirements, and may therefore require product modifications.

De facto standards are industrial standards that apply to products, in addition to the generally valid norms and standards. These standards are defined by companies or organizations. As these de facto standards are widely applied and help to ensure low cost levels, they are accepted worldwide. Examples include standard operating systems, interface definitions and electronic components derived from de facto standards (special processors, controllers, ASICs). Companies that define de facto standards solely by way of their market position may change the de facto standard without coordination with other par-ties and within a short period of time. In this case, the changes have a direct and strong impact on the Life-Cycle-

Management of automation products. For example, new operating systems, changes to processor designs, or a new ASIC may mean that compatibility requirements are no longer fulfilled. Users of the respective systems and plants must monitor these changes and respond to such situations through appropriate Life-Cycle-Management strategies, such as stock-piling spare parts. Such changes can also impact certification or the approval to operate the plant.

6.2 Porter's Five forces Analysis Model

However, these five forces are not independent of each other. Pressures from one direction can trigger off changes in another which is capable of shifting sources of competition. In the following section each of these five forces are discussed in detail as to understand how each of these forces affect an Industry's environment so that one can identify the most appropriate strategic position within the industry.



1) Threat of New Entrants

Entry of a firm in and operating in a market is seen as a threat to the established firms in that market. The competitive position of the established firms is affected because the entrants may add new production capacity or it may affect their market shares. They may also bring additional resources with them which may force the existing firms to invest more than what

was not required before. Altogether the situation becomes difficult for the existing firms if not threatening always and therefore they resort to raising barriers to entry. These barriers are intended to discourage new entrants and this may be done by organisations, be in any one or more ways, as discussed below:

a) **Economies of Scale:** Firms which operate on a large scale get benefits of lower cost of production because of the economies of scale. Since the new firm normally would start its operation at a smaller scale and therefore will have a relatively higher cost of production, its competitive position in the industry gets adversely affected. This barrier created through large scale of operation is not only applicable for production side but it can be extended to advertising, marketing, distribution, financing, after sales customer service, raw materials, purchasing and Research and Development as well. For example, you would have noticed in durable industry the kind of investments which players like Samsung and LG do on advertising and promotions normally and specially during events like World Cup cricket match. This makes it nearly impossible for any new third player to launch and sustain such intensive and investment driven maketing attack.

b) **Learning or Experience Effect:** The theory explaining the experience curve or the learning curve suggests that as firms produce they grow more efficient and this brings them cost benefits. The efficiency levels achieved is an outcome of the experience, which teaches the organization better ways of doing things. This again keeps any new entrant at a disadvantage.

c) **Cost Disadvantage Independent of Scale:** New entrants may face disadvantages which are independent of the operations. It may be on account of the lack of proprietary product knowledge such as patents, favourable access to raw material, favourable locations, existing plants built and equipped years earlier at lower costs, lower borrowing costs etc.

d) **Brand benefits:** Buyers are often attached to established brands. Differences in physical or mere perceived value make existing products unique and the new entrants have to tire out to beat such brands and change the mindset of the customers.

e) **Capital Requirements:** High investments required for a start up in any business is another deterrent for new entrants bringing down the possibility of increased competition.

f) **Switching Costs:** Switching costs, which is nothing but the expenses (financial or psychological) which a customer incurs in switching from one seller to another. Cases where such an expense is higher, new entrants find it difficult to establish or survive. Such costs may be because of a strong brand association or the comfort level a customer may be enjoying or it may be on account of a particular technology like Windows operating systems which most customers use and therefore will find it inconvenient to switch to a system like LINUX so easily.

g) **Access to Distribution Channel:** Any such critical activity like distribution channel in the business can be a barrier for the entrants when accessibility to them is found to be difficult. Most existing firms in FMCG industry are found to have a strong favourable distribution channels which is very difficult to penetrate. For example in India you can think of HLL which commands a deeply entrenched distribution network.

h) **Anticipated Growth:** Incumbents in a rapidly growing market are less likely to respond to a new entrant when the market's growth offers enough opportunities to share. But a new entrant position will be opposite in a slowly growing market. In addition to the above, few general entry barriers exist in each industry's case, for example, regulatory policies, tariffs and international trade restrictions are few such additional factors.

2) Bargaining Power of Suppliers

Business organizations have a large dependency on suppliers and the latter influence their profit potential significantly. Suppliers' decisions on prices, quality of goods and services and other terms and conditions of delivery and payments have significant impact on the profit trends of an industry. However, suppliers' ability to do all these depends on the bargaining power over buyers.

Suppliers' bargaining power would normally depend on:

a) **Importance of the Buyer to the Supplier Group:** The size of the supplies taken by a particular buyer is likely to put the buyers in a relatively advantageous position. The same may be found true if the supplier tends to get an image advantage by supplying to a particular firm. Consequently in dealing with such buyers, suppliers' bargaining power is naturally reduced. Just opposite happens when buyer is not so important to the supplier and the latter then is less likely to offer favourable terms to win or retain the customer.

b) **Importance of the Supplier's Product to Buyers:** Here the position may just be opposite of the above situation where suppliers have a better bargaining power coming from their sheer size or image.

c) **Greater Concentration Among Suppliers than among Buyers:** An industry, which is largely dominated by a few large firms is a highly concentrated industry. Such few firms hold greater power with them as the proportion of the industry's total output is in hands of such large firms. This gives such firms greater power over those who do business with them. The converse is true when industry has low concentration in suppliers. A higher concentrated supplier position may be possible on account of the sources of raw materials available, R & D or patent rights available with fewer firms.

d) **High Switching Costs for Buyers:** In this case buyers suffer because of the suppliers' advantageous position or by the nature of supplies itself, the buyers have to face a higher switching cost.

e) **Credible Threat of Forward Integration by Suppliers:** Suppliers in a given situation may see an opportunity in moving up the value chain and may seriously think of getting into the business of what its buyers have been doing till now. Any indication of that nature from supplier side puts the buyers at the receiving end as they feel threatened because of a new player in that market and of losing an assured source of supplies. A recent example may be of Reliance which has decided to move from exploration and refining of oil to sealing of oil through its own retail petrol pumps.

3) <u>Bargaining Power of Customers</u>

Customers with a stronger bargaining power relative to their suppliers may force supply prices down or demand better quality for the same price and may demand more favourable terms of business. For instance, there will always be a difference in the bargaining power between an individual's buying different construction material like cement, steel or bricks and a real estate builder buying them for the number of properties he may have been building over so many years.

Few of the following facts attach greater power to buyers:

a) **Undifferentiated or Standard Supplies:** A supplier, given the nature of products it supplies, may have a very limited choice in providing any differentiated products and this enables a customer to get the deal at the most favourable terms. In a perfectly competitive market situations with large number of suppliers, prices automatically are at their lowest.

b) **Customer's Price Sensitivity:** Customer's buying behaviour vary with respect to their sensitivity to prices. Depending on how important the item is for the customer's usage and proportion he may be spending on the item concerned, buyers' sensitivity to price varies. Any customer with high price sensitivity gains advantage in its bargaining power.

c) **Accurate Information about the Cost Structure of Suppliers:** A more informed customer is capable of negotiating with suppliers. Whenever such customers notice a decline in the supplier's costs they would always bargain for a proportional decrease in price. This aspect is more relevant in today's context of global markets where cost benefits can come from anywhere in the world at any point in time for various reasons. There may be a general decline in prices of a product in world market because of a glut situation or somewhere some new discoveries may have pulled the prices down.

d) **Greater Concentration in Buyer's Industry than in Supplier's Industry and Relatively large Volume Purchase:** This means that buyers are large and more powerful than suppliers. Government departments like police department when negotiating for large orders of security weapons or intelligence equipments will necessarily command a greater hold than its supplier as there will be only few number of such institutions buying them at a given point of time.

e) **Credible threat of Backward Integration by Buyers:** Different from forward integration which suppliers tend to attempt at, buyers in order to hold their position stronger in the market may integrate in backward manner. This will mean that the buyer extends itself to the previous stage of manufacturing or distribution for which it had been dependent on suppliers till now. An example could be of an entertainment channel which airs programmes outsourced from organizations producing them outside, get into the business of producing its programmes in house.

4) <u>Threat of Substitutes</u>

Often firms in an industry face competition from outside industry products, which may be close substitutes of each other. For example, with the new technologies in place now the electronic publishing are the direct substitutes of the texts published in print. Similarly, newspaper find their closest substitutes in their online version, though it may be a smart strategic move to position them as complementary products.

However, the competitive pressure, which any industry may face, depends primarily on three factors:

1) Whether the substitutes available are attractively priced;

2) Whether buyers view substitutes available as satisfactory in terms of their quality and performance;

3) How easily buyers can switch to substitutes.

Generally it is observed that the availability and acceptability of substitutes determine an upper price limit to a product. When relative prices of the product in question rise above that of the substitute products, customers tend to switch away from them.

5) Competitive Rivalry

The level of rivalry is minimum in a perfectly competitive market where there are large number of buyers and sellers and the product is uniform with everyone. Same is true for a monopoly market where there is only one player and the type of product is also one. However in case of oligopoly or monopolistic competition, where you will find few players and the market conditions allow them to differentiate their products and services, competition if found to be fierce. Few of the following factors explain the level of rivalry:

a) **The Stability of Environment:** An unstable environment is likely to call for a hyper-competitive situation and of the several factors that affect stability could be technological innovation, changes in government regulations, customers' profile and their needs. In an industry which witnesses high movements in terms of entry or exit, the rules of the game may change too frequently. One of such instances of fierce competition could be noticed on account of the onslaught of new technologies like CDMA affecting the general environment of telecom industry in India. The entry of Reliance India Mobile with CDMA technology intensified the rivalry between telecom players to such an extent that the government had to intervene through its institution, Telecom Regulatory Authority of India (TRAI).

b) **The Life Expectancy of Competitive Advantage:** There are industries for example consumer electronics or white goods in which the fruits of innovations do not last longer and hence the companies do not even bother to patent them.

This has an adverse implication for the stability of the competitive environment leading to intense rivalry. Length of innovation cycle, patent protection or switching costs between rivals are few factors, which may impact the life expectancy of competitive advantage.

c) **Characteristics of the strategies pursued by competitors:** This also has or may have an impact on the general approach to rivalry. For example, in a market segmented approach on part of the competitor leads to lesser rivalry situation. Also the kind of goals, which competitors pursue has an impact on the rivalry. Competitors pursuing the goal of increased market share will lead to increased rivalry again.

Lastly, few implications can be picked up from the five forces framework itself. Lower threats to entry or a higher possibility for substitutes have the potential of increasing rivalry. A lower engagement between supplier will result into a lesser rivalry. So will be the effect when buyers face higher switching costs.

In an overall assessment, two critical observations regarding rivalry can be made here. First a powerful competitive strategy employed by one rival can greatly intensify the competitive pressure on other rivals. Second, the frequency and rigor with which rivals use any or all competitive weapons at their disposal can be a major determinant of whether the competitive pressures associated with rivalry are cut throat, fierce, strong, moderate or weak.

PORTER'S 5 FORCES ANALYSIS ON AUTOMATION INDUSTRY

Supplier Power High, Stable

The cost of materials is the Electrical Equipment Manufacturing industry's largest expense item. Materials include steel, copper, aluminum, silver, nickel, zinc, mineral oil and plastics. In addition, industry players purchase fabricated products and electronic components. A rise in the price of raw materials in recent years will be largely offset by this industry's pricing actions. Unless this industry find substitute for its manufacturing, otherwise the power of supplier will still be stable.

Barriers to Entry: Medium, Stable

The major barriers to entry for this industry include: access to the latest technology and to skilled employees; and the benefits of reputation and critical mass of incumbents. The largest players in this industry have global operations, established production facilities and distribution arrangements, internally developed and acquired technologies, a large range of products,and well known brand names. Established large firms can have relatively low unit costs. Scale can also increase negotiating power in purchasing raw materials. New fast-developing small companies are usually acquired by large companies in this industry.

Buyer Power: Medium, Stable

Customers are typically involved in contracts with certain companies and therefore are unable to switch for a certain years. Orders are also typically very large and it is inefficient for the customer to switch companies because of the personalization of the products. In the future, customers also need update and service from the companies that they signed agreements with. Since the machines usually lasts long time, customers tend to choose well-reputed companies that can provide better service.

Threat of Substitutes: High, Increasing

Substitute goods in the electrical manufacturing equipment industry are a big threat to Rockwell, which is an increasing trend. There are many competitors in this industry. As the economy worsens and price sensitivity becomes higher, a switch to a less expensive producer becomes more likely. Especially, the imports have price-advantage. There are also increasing imports which intimidate domestic manufacturers.

Degree of Rivalry: Medium, Increasing

The major bases of competition include: product quality and performance; the range of products and services offered; and price. The ability to provide high performing and reliable electrical equipment can be important given the nature of some customers and end-users who, in turn, seek to provide highly reliable products and services. In addition, customers often wish to minimize replacement, repair and maintenance expenditures. Rockwell can rely on its brand loyalty and awareness and its advanced technology to compete other substitutes and also retain customers. Companies that are able to supply equipment that offers users with increased utility and/or lower operating costs will often have a competitive edge. R&D and strategic alliances can assist in gaining access to competitive products, as well as to production technologies.

6.3 S.W.O.T. ANALYSIS

Strengths:

• Global customer/prospect strategy

• High R&D and Technology competitive advantage

• implementing common global process standards and an enterprise-wide information system

• Diverse products from design and installation through operation and maintenance.

• A broad range of products and services can assist in providing customers with a total solution and can sometime result in complementary sales.

Weaknesses:

• High cost on IT

• High dependence on the health of the economy

Opportunities:

• Emerging markets of Asia Pacific, including China and India, Latin America and eastern Europe (additional growth opportunities)

• Original Equipment Manufacturers (OEMs)

• Utility regulators are now incorporating incentives for energy efficiency in utility rate determinations, creating

opportunities for infrastructure improvements

• New transportation infrastructure plan

Threats:

• Low-cost imports as substitutes

• Mature market

• Slow down in industrial production

• Pricing pressures

• currency exchange rates, inflation rates, interest rates, recession, policies of foreign governments

Chapter 7: Futuristic Scenario of the Automation Industry

Since the turn of the century, the global recession has affected most businesses, including industrial automation. After four years of the new millennium, here are my views on the directions in which the automation industry is moving.

The rear-view mirror

Because of the relatively small production volumes and huge varieties of applications, industrial automation typically utilizes new technologies developed in other markets. Automation companies tend to customize products for specific applications and requirements. So the innovation comes from targeted applications, rather than any hot, new technology.

Over the past few decades, some innovations have indeed given industrial automation new surges of growth: The programmable logic controller (PLC) – developed by Dick Morley and others – was designed to replace relay-logic; it generated growth in applications where custom logic was difficult to implement and change. The PLC was a lot more reliable than relay-contacts, and much easier to program and reprogram. Growth was rapid in automobile test-installations, which had to be re-programmed often for new car models. The PLC has had a long and productive life – some three decades – and (understandably) has now become a commodity.

At about the same time that the PLC was developed, another surge of innovation came through the use of computers for control systems. Mini-computers replaced large central mainframes in central control rooms, and gave rise to "distributed" control systems (DCS), pioneered by Honeywell with its TDC 2000. But, these were not really "distributed" because they were still relatively large clumps of computer hardware and cabinets filled with I/O connections.

The arrival of the PC brought low-cost PC-based hardware and software, which provided DCS functionality with significantly reduced cost and complexity. There was no fundamental

technology innovation here—rather, these were innovative extensions of technology developed for other mass markets, modified and adapted for industrial automation requirements.

On the sensor side were indeed some significant innovations and developments which generated good growth for specific companies. With better specifications and good marketing, Rosemount's differential pressure flow-sensor quickly displaced lesser products. And there were a host of other smaller technology developments that caused pockets of growth for some companies. But few grew beyond a few hundred million dollars in annual revenue.

Automation software has had its day, and can't go much further. No "inflection point" here. In the future, software will embed within products and systems, with no major independent innovation on the horizon. The plethora of manufacturing software solutions and services will yield significant results, but all as part of other systems.

So, in general, innovation and technology can and will reestablish growth in industrial automation. But, there won't be any technology innovations that will generate the next Cisco or Apple or Microsoft.

We cannot figure out future trends merely by extending past trends; it’s like trying to drive by looking only at a rear-view mirror. The automation industry does NOT extrapolate to smaller and cheaper PLCs, DCSs, and supervisory control and data acquisition systems; those functions will simply be embedded in hardware and software. Instead, future growth will come from totally new directions.

New technology directions

Industrial automation can and will generate explosive growth with technology related to new inflection points: nanotechnology and nanoscale assembly systems; MEMS and nanotech sensors (tiny, low-power, low-cost sensors) which can measure everything and anything; and the pervasive Internet, machine to machine (M2M) networking.

Real-time systems will give way to complex adaptive systems and multi-processing. The future belongs to nanotech, wireless everything, and complex adaptive systems.

Major new software applications will be in wireless sensors and distributed peer-to-peer networks – tiny operating systems in wireless sensor nodes, and the software that allows nodes to communicate with each other as a larger complex adaptive system. That is the wave of the future.

The fully-automated factory

Automated factories and processes are too expensive to be rebuilt for every modification and design change – so they have to be highly configurable and flexible. To successfully reconfigure an entire production line or process requires direct access to most of its control elements – switches, valves, motors and drives – down to a fine level of detail.

The vision of fully automated factories has already existed for some time now: customers order online, with electronic transactions that negotiate batch size (in some cases as low as one), price, size and color; intelligent robots and sophisticated machines smoothly and rapidly fabricate a variety of customized products on demand.

The promise of remote-controlled automation is finally making headway in manufacturing settings and maintenance applications. The decades-old machine-based vision of automation – powerful super-robots without people to tend them – underestimated the importance of communications. But today, this is purely a matter of networked intelligence which is now well developed and widely available.

Communications support of a very high order is now available for automated processes: lots of sensors, very fast networks, quality diagnostic software and flexible interfaces – all with high levels of reliability and pervasive access to hierarchical diagnosis and error-correction advisories through centralized operations.

The large, centralized production plant is a thing of the past. The factory of the future will be small, movable (to where the resources are, and where the customers are). For example, there is really no need to transport raw materials long distances to a plant, for processing, and then transport the resulting product long distances to the consumer. In the old days, this was done because of the localized know-how and investments in equipment, technology and personnel. Today, those things are available globally.

Hard truths about globalization

The assumption has always been that the US and other industrialized nations will keep leading in knowledge-intensive industries while developing nations focus on lower skills and lower labor costs. That's now changed. The impact of the wholesale entry of 2.5 billion people (China and India) into the global economy will bring big new challenges and amazing opportunities.

Beyond just labor, many businesses (including major automation companies) are also outsourcing knowledge work such as design and engineering services. This trend has already become significant, causing joblessness not only for manufacturing labor, but also for traditionally high-paying engineering positions.

Innovation is the true source of value, and that is in danger of being dissipated – sacrificed to a short-term search for profit, the capitalistic quarterly profits syndrome. Countries like Japan and Germany will tend to benefit from their longer-term business perspectives. But, significant competition is coming from many rapidly developing countries with expanding technology prowess. So, marketing speed and business agility will be offsetting advantages.

The winning differences

In a global market, there are three keys that constitute the winning edge:

- Proprietary products: developed quickly and inexpensively (and perhaps globally), with a continuous stream of upgrade and adaptation to maintain leadership.
- High-value-added products: proprietary products and knowledge offered through effective global service providers, tailored to specific customer needs.
- Global yet local services: the special needs and custom requirements of remote customers must be handled locally, giving them the feeling of partnership and proximity.

To implementing these directions demands management and leadership abilities that are different from old, financially-driven models. In the global economy, automation companies have little choice – they must find more ways and means to expand globally. To do this they need to minimize domination of central corporate cultures, and maximize responsiveness to local customer needs. Multi-cultural countries, like the U.S., will have significant advantages in these important business aspects.

In the new and different business environment of the 21st century, the companies that can adapt, innovate and utilize global resources will generate significant growth and success.

Main Technology Trends:

Some of the main technology trends in industrial automation are discussed in this section.

Technology Shifts: The industrial automation market periodically undergoes major shifts as new technologies improve the functionality and economics of industrial monitoring and control systems. The introduction of wireless sensor networking (WSN) represents just such a sea change. While proprietary P2P and P2MP wireless technologies have been used in a limited fashion since the 1980s to integrate a few hard-to-wire field devices into an overall

wired control system, standards-based WSN promises to dramatically expand the number of devices in a plant that can be connected wirelessly. In contrast to P2P and P2MP connections, WSN utilizes self-forming, self-healing mesh networking to enable field devices to be deployed cost effectively without the need for site surveys or specially trained field technicians to manually configure directional antennas. Emerson Process Management estimates that WSN enables cost savings of up to 90% compared to the deployment of wired field devices.

However, WSN will not be appropriate for all industrial automation applications. The capabilities need to be carefully assessed before selecting it.

Productivity: The fundamental purpose of industrial automation is to improve productivity – generate increased output with reduced costs and facilitate increased output by reducing the costs. The intrinsic value of each and every piece of automation equipment has the ability to provide increased productivity for the customer as well as to the users.

Productivity has now become a global race, an international competition between regions and nations for the single reason that it results in wealth and is the key to improvements in living standards. Increased productivity means things are made more cheaply and more quickly.

Knowledge workers: When reliable information is not readily available, it can lead to duplicated efforts between multiple business units, loss of sales or productivity, and poor decision making based on faulty information. All of these effects, from a lack of information, cost money.

In many situations, workers are unable to find the information they need because of inadequate, inaccurate, or delayed information. In today's information age, data needed to make decisions should be made available to all workers in an effortless fashion. Often workers waste time trying to find data by waiting on faxes or printed reports, searching through paper filing systems, or re-entering data from existing sources to create customized reports in a spreadsheet application. Data important to decision making should be easily accessible to

workers through database driven, dynamic web portals or other centralized corporate applications.

A number of domain specific software is available to resolve this issue and bring significant value to productivity. These applications can be implemented either using off-the-shelf software or with specific customization for the industry. Over the years, the automation engineers have kept pace with the changing technologies and software in particular to be able to define the specifications as desired.

Offshore Outsourcing: In this era of globalization, entrepreneurs are always looking ahead to beat competition. The new trend is - offshore outsourcing. The concept involves taking internal company functions and paying an outside firm to handle them, which enables the entrepreneurs to divert their full attention towards core competencies. Thus they can focus on their primary business.

Although Software outsourcing is the buzzword in the industry, outsourcing of all kind of business is now happening. Though the most visible benefit of this is cost savings, there are a number of other factors that influence the decision to outsource to an offshore partner. Some of them are discussed below:

The China Challenge

In today's global environment whoever manufactures products better, cheaper and faster, wins. Every country in the world is competing. In consumer products, China is grabbing a lot of the prizes. And they're moving strongly into high-tech.

Some of the facts about manufacturing in China today:

- It is continually increasing its manufacturing prowess
- There are significant cost advantages (beyond just labor cost)

- It involves a good, repetitive quality which facilitates productivity
- It has a worldwide market-share – 50% of cameras, 30% of air conditioners and televisions, 25% of washing machines, 20% of refrigerators
- One private Chinese company makes 40% of all microwave ovens sold in Europe
- The city of Wenzhou, Eastern China produces 70% of the world's metal cigarette lighters
- Walmart – Buys $18 billion from China, providing a direct link to the US consumer

Market Predictions:

- Nano technology and nano scale assembly systems
- Machine to machine networking
- Bio-electronic devices
- Complex adaptive systems
- Wireless everything
- Fully automated factories

Nano Technology

The commercial interest in nanotechnology is being driven by visions of a stream of new nanotech commercial products and applications that will lead to a new industrial revolution - a revolution in which almost every industry is likely to be affected. It will be possible to produce new materials with desired properties: smaller, stronger, tougher, lighter and more resilient than anything that has ever been made. Molecule-size components are being assembled into complex composites and

"smart" materials. For example, nano structured membranes are being developed for efficient filtering of pollutants from water or air. nanotech, today's supercomputer could become tomorrow's wristwatch PDA.

Machine to machine networking

The convergence of smart devices with the internet is creating a new inflection point. Manufacturers can use their connected products to develop customer service relationships that can ultimately recreate the basis of customer management and generate new revenue streams in an information economy.

This will far surpass human communications in scope, value, and sheer numbers. the next few years, more machines will be connected via the internet than humans. Eventually reaching tens of billions of connections, machines will communicate with each other, as well as with data mining and processing systems that will automate the communication and of the mass of data they gather. This will add significant value for businesses and consumers. Complex adaptive systems

Complex adaptive systems yield significant advances through reduced software, and easier installation, robust performance, vastly improved flexibility, to handle very much larger I/O point-counts. Traditional concepts of fault-tolerance become obsolete, because redundancy is provided directly at the I/O level. Complex adaptive systems are robust because the behavior is not dependent on single, or even multiple failure points. Failure of any single part of the system is accommodated. CAS has the ability to achieve much higher levels of performance through emergent behavior and self-organizing capabilities.

Wireless Connections

The connectivity infrastructure is moving very quickly to connect everyone and everything to the Internet, not only through high-speed DSL and cable-modems, but soon through wireless.

The impact on industrial controls will be significant. Connecting automation products with conventional wire beyond the confines of a typical system enclosure is still a major hindrance in the typical factory. This inevitably gave rise to what was previously called islands of automation.

Wireless mobility and information services already bring voice, entertainment, Internet access and safety services into cars and trucks. The automobile is quickly becoming the center of a complete range of connected appliances.

Fully automated factories

Automated factories and processes are too expensive to be rebuilt for every design change - so they have to be highly configurable and flexible. To successfully reconfigure an entire roduction line or process requires direct access to most of its control elements-switches, valves, motors and drives-down to a fine level of detail.

With technology available today, fully automated factories - in a truly realistic sense - are quickly becoming an accepted fact.

CONCLUSION

Every industry in the world of industrialization is driving its workforce to produce the maximum in less time. This has given birth to the idea of reducing the production turn-around time, and this in turn has created the need for industrial automation. The concept has provided relief to factory owners by reducing human intervention and controlling industrial machinery and process. Control systems such as numerical control, programmable logic control and other industrial control systems work hands-on with other information technology applications like CAD and CAM. This advanced technology can be considered as a step beyond mechanization, as it reduces the effort of human operators.

Another major shift in automation is the increased demand for flexibility and convertibility in manufacturing processes. Manufacturers are increasingly demanding the ability to easily switch from manufacturing Product A to manufacturing Product B without having to completely rebuild the production lines. Discrete manufacturing plants adopted these technologies fast. The more conservative process industries with their longer plant life cycles have been slower to adopt and analogue-based measurement and control still dominates. The growing use of Industrial Ethernet on the factory floor is pushing these trends still further, enabling manufacturing plants to be integrated more tightly within the enterprise, via the internet if necessary. Global competition has also increased demand for Reconfigurable Manufacturing Systems.

Therefore, the task ahead for automation—creating complex systems for a rapidly expanding range of applications and human activities—appears quite challenging. However, its before long that we will know what the future holds for us. Pessimists have already begun to worry about what is going to replace automation.