# EXECUTIVE SUMMARY AND RECOMMENDATIONS

Control and Instrumentation sector has been recognised as one of the catalysts of technological growth in the highly industrial economies. In all process industries,the products of the sector, have become inevitable for precise measurement and control of whole processes, physical parameters, and others. The process control instrument has become an integral part of modern industrial activity.

## 0.1 DEFINITIONS

The term Process is used to describe the collective functions performed in and by the equipment in which one or more variables are to be controlled. Process variables are physical or chemical quantities, the variations of which affect the operation of a manufacturing process. Process Control is the application of automatic control theories and hardware to operations found in process industries.

## 0.2 Application Areas

Process control is the application of automatic control theories and hardware to operations found in process industries. These industries handle three types of materials-fluids, bulk solids and sheeted and welded materials. The most important variables measured and controlled in the process industries include temperature, pressure, vacuum, flow, liquid level, bulk solid level, density, vibration, electrical parameters, specific gravity and chemical composition including pH, oxidation-reduction potential and many forms of spectrometry and spectrophotometry.

## 0.3 Historical Development of the Industry

The development of control and instrumentation sector has undergone transformation in phases. Early processes were relatively simple and plant size small. Measuring instruments were mounted directly on the process lines. Monitoring and recording of measured values were performed by plant operators. As the plant size and process complexity increased, the number of critical parameters that needed to be measured and monitored also increased. This led to the requirement for a centralised monitoring of process variables, and the introduction of signal transmitters and transmission techniques. The first system employed pneumatic transmitters of the forced balance type. Manual control gave way subsequently to automatic control implemented through pneumatic controllers. Later electronic controllers began to gain ground.

## 0.4 Technology Status - International Scene

The domain of primary sensing elements comprises of measurement of flow, level, temperature, pressure, vibration, electrical parameters and analysers.

Development in flow elements is targetted towards reducing pressure loss and increasing accuracy. Sensing devices have been developed for flow measurements in viscose fluids, as well as, media having shaped material. Ultrasonic and radiation sensors have been deployed for continous level measurements. In the area of temperature mesurement a new concept has been evolved by optical means. Sensors are now developed for pressure measurements with integral temperature sensors for broad range of applications.

Among the secondary instruments which measure differential pressure, greater emphasis is on the technology of circuit design to improve accuracy, repeatability and less hystersis. Laser techniques are being used to trim the passive elements to give dynamic compensation for ambient temperature change to improve overall performance.

Electronic circuits using CMOS technology and optional digital outputs are available for compatibility with other digital equipments. Microprocessor based recorders, controllers, indicators, transmitter control accessories, special purpose control stations are extensively used in varied industry segments *viz.* steel, cement, petrochemicals, fertilizers and refineries.

The development trends in control valve design have been in utilisation of newer alloys and materials of construction with special attention being given to customising of designs. Valves have been developed for specific industry application *viz.* nuclear power plant, oil exploration, etc.

A greater thrust is towards developing fire safe designs. The PLCs are now designed around microprocessors. In the area of closed loop control the microprocessor based PID controllers are already available. The open loop and closed loop systems are being merged in a unified distributed digital control system. The advent of single chip micro computers with powerful processing capabilities has been responsible for such a development.

In process industries supervisory computer plays a significant role. Recent avilability of powerful 16 bit, 32 bit and bit slice processors have changed the domain of system development and system engineering, 32 bit computers with real time software are replacing 16 bit machines.

Data is transmitted over distributed control system network using optical fibres. This offers considerable advantages when distances are long or when adverse ambient conditions such as large differences in electric potential or electromagnetic interferences prevail.

## 0.5 Indian Scenario

Following industrialisation India has established over the years reasonably sound technological base in many industries including process oriented

industries like steel, power, cement, fertilisers, petrochemicals and refineries. In developing these the need for process control instrumentation was apparent.

0.6 **Indigenous Development**

The development of process control industry in India dates back to the 1930 s. Till 1960 little progress was made in the domestic production scenario. The industry started developing from the early 70 s. By mid 1970 s the product range was considerably enlarged and production trend recorded improvement. With the development of electronics since the 80 s the industry had considerable vertical and horizontal growth.

0.7 **Product-range**

The product range covers field hardware, field interface, control system and control room equipment. The industry covers (a) Design of Systems to meet various process configurations (b) Manufacture and Supply of various instruments, control panels and equipments and (c) Installation and Commissioning of process control systems.

0.8 **Structure of Industry**

The industry is generally dispersed. Small and medium sized units compete successfully with organised sector units. The small firms production tends to be generalised whereas the bigger firms, in many cases, either produce instruments alongwith capital goods or have diversified into instruments production and system engineering. The organised sector commands 60% of the value of output, the balance 40% is accounted for by the small scale sector. The industry cannot be clearly defined as a capital or labour-intensive industry. On the one hand, the manufacture of highly complex and sophisticated instrumentation system produced in small numbers rather for specific customers constitute a labour intensive part of the industry. On the other hand, manufacture of many process control instuments which involve fairly large production runs is more capital intensive.

0.9 **Capacity**

The total capacity covering both organised and non-DGTD sector is estimated at Rs. 790 crores as of 1988-89. The total installed capacity in the organised sector is estimated at Rs. 350 crores. The current production is assessed at Rs. 150 crores in hardware.

0.10 **Exports**

The export trend has not registered significant growth over the years. At present it is difficult to sustain an export market in the field because of the level

of quality and sophistication required and production cost to be made competative with world market.

0.11 In the past there has been large scale imports of process control instrumentation as a part of total package for a number of core sector industries. The production plans made by certain manufacturing units have suffered because of the soft option of many process industries for importing the entire package of process control instrumentation alongwith other plants and machinery.

0.12 **Demand Profile**

The Development Council for Instrumentation Industry has estimated the demand for 8th Plan period at Rs. 3170 crores, comprising of Rs. 1895 crores of hardware equipments and Rs. 1275 crores of software and services.

0.13 **Investment Profile**

An investment of Rs. 105.34 crores is envisaged during 8th Plan Period, comprising of Rs. 40.14 crores and Rs. 65.20 crores in public and private sectors respectively.

0.14 **Technology Transfer**

Transfer of technology has been the cornerstone of indigenous development of control and instrumentation segment. There has been few cases of technology tie ups in the 60 s and 70 s. The real thrust came in the decade of 80 s. The major focus earlier was in the area of pneumatic and analog instrumentation. This has shifted in favour of electronic control instruments in recent years. The Government policy has been geared to facilitate the process of technology transfer so that the industry is equipped with latest state-of-the-art which should be completely indigenised through sustained development of in-house R&D and other supportive facilities.

0.15 **Technology Status**

Transfer of technology has been the major foundation of indigenous development. The technology tie up with internationally reputed manufacturers has brought in technological break through, in various areas of the industry.

In the area of process measurement and control instrumentation India has developed its own base for manufacturing the process instrumentation. The technology in India aims to meet the basic needs. In the domain of flow sensors, variable area flow meters in glass/metal tubes, head flow meters, pilot tubes, magnetic flow meters, wires, flumes for various applications are available indigenously.

The existing technology in India for level sensors provides the tape level

devices, float level devices, air/nitrogen purge type level measurement differential pressure devices, displacer type level devices, capacitance probes, ultrasonic and radiation level gauges.

The existing technology in the area of temperature sensors covers (a) Industrial Glass Thermometers (b) Bi-metallic Thermometers (c) Filled System thermometers conforming to SAMA classifications I, II, III, and IV. (d) The Electrical Methods of temperature measurement employ resistance thermometers and thermocouples.

The existing technology in India provides sensors for a wide range of pressure measurement employing diaphragms, bellows and bourdon elements.

Liquid analysers form one component of on-stream analysis. In this area existing technology primarily meets the demands of boiler feed water treatment and to make some spot measurements in effluent treatment plants. The technology for Gas Analysis is complex. However, a base exists in India to manufacture (a) Paramagnetic Oxygen Analyser, (b) Electro-chemical Oxygen Analyser, (c) Double Beam Infrared Spectrophotometer and (d) U.V. Spectro-photometer.

There is no proven technological base in India in Industrial Quality Sensors. In the sphere of Control Room Instrumentation, process industries in India deploy functional needs of the process operation.

India has a strong technological base to manufacture final control elements that are needed for normal service in large volume. In essence, the technology available in the country caters to the needs of the process industies where the requirements are not very stringent. However, there are some exceptional cases where considerable indigenous efforts have been made to meet high pressure boiler feed water valves and high pressure steam valves.

0.16 **Indigenisation**

The existing manufacturing facilities available with various manufacturers are quite satisfactory for pneumatic and electronic analog instruments. The manufacturers have to master the state-of-the-art in certain specialised fields where efforts are required for indigenisation. The country falls far short of indigenous tehnological base for microprocessor based equipments and systems. Despite technology tie up the manufacturers have not been able to fully assimilate the technology. Product development demands considerable time and investment. The investment on R&D is small except in a few large units. The necessary infrastructure, R&D base, testing facilities, quality control techniques, man power development and maintenance support call for required level of expertise.

0.17 **Technology Gap**

There exists a gap between technology existing in India and contemporary international technology. The gap is further accentuated by the fact that the obsolescence of technology in the field of instrumentation is very rapid.

There are varying stages of gaps reflected in total absence as well as limited availability of technology. Some of the technology gaps are seen in the areas of volumetric methods of flow measurement. The technological trend abroad in level sensors is to improve basic level sensors to get over their application limitations. In temperature sensors the technology abroad has made rapid strides in electrical methods of measurement to bring about low cost fast response sensors. Silica analysers is one vital area of boiler feed water monitoring that needs manufacturing base in India. There is no proven technological base for : i) Density, (ii) Viscosity, (iii) Flame sensors, (iv) Leak Detectors, (v) Noise sensors, (vi) Displacement and proximity sensors, (vii) Tramp metal detectors, (viii) Torque transducers and (ix) Vibration monitoring.

In control Room Instrumentation, the potential of process control and information systems to optimise operations at plant level is yet to be fully exploited. The technology gaps are conspicuous in areas of Distributed Digital Control Systems (DDCS), Supervisory Computer for process optimisation. However, this area is indicative of continuous dependence on imported technology. Around 53 collaborations (36.5% of the total number of collaborations in the domain of process control) have been entered in the control systems area during the period 1981 - 89. There is a pertinent need to make attempts at the national level of bridging the technology gap in this area.

In the domain of control valves, the gaps are prominent in special purpose valves required for nuclear, fertilizers, oil and subsea applications.

0.18 **Conclusions**

(a) Very recently instruments and instrumentation are being referred to as an industry. However, a separate industrial classification is yet to emerge out. This requirement has also been voiced by industry many a time. This may be looked into by the appropriate organisation.

(b) The major share of investment is accounted for by the printed board assembly and testing acitvity. This implies that to make the facility economically viable, there must be a large volume of printed circuit boards produced. This realisation gives rise to the concept of a central printed circuit board manufacturing facility which would cater to the needs of number of product manufacturing units of a company.

(c) In certain instruments the Indian industry as yet is dependent on foreign standards. Though Bureau of Indian Standards (BIS) is in the process of preparing certain important standards, the list is inadequate for diversified ranges.

(d) Bipolar ICs, memories different types of switches, capsules, bellows, and others are important components required for development and manufacture of instruments are in short supply. Among these, Bipolar IC is most crucial. BEL is the largest manufacturer in this fields its yield is not upto international standards. Though this segment is open to private segment, investors are reluctant to commit large investment required in this area for a number of reasons. Unless therefore, the indigenous production is of international standard, the industry may have to depend on imports.

(e) Process Control Instrumentation industry in the country is about 20 years old. During these years both users and manufacturers had built reasonably trained manpower base to operate pneumatic and electronic analog instruments. With the technology moving into the digital domain, the manufacturers have been able to build sufficiently good facilities for engineering, manufacturing, erection and commissioning. The same is not true with the user industry as proper training facilities are not available, this need to be provided

(f) Testing laboratories and Certifying Agencies in India have yet to instil a greater level of confidence in the users towards accepting indigenously manfuctured instruments of various categories, by ensuring certain minimum standard of excellence in quality and reliability.

(g) In India, the investment on R&D is incurred by a few large units. The units surveyed do not indicate any consistency in the level of investment in R&D. A greater emphasis on development work is required to be given particularly for a fast developing industry as this.

(h) Since the process control instruments industry encompasses a wide variety of instruments often needed in small numbers, it is not always economical for the organised sector to take up their manufacture. The small scale sector with its lower overheads has, therefore, a very important role to play.

0.19 **Recommendations**

(a) Establishment of a central body for process control instrumentation to oversee policy and adherence is expected to be useful.

(b) Technology watch cells with the objective of keeping a track on technology trends and indigenous capabilities would be useful. It is desirable

that these cells estimate the requirement of design and the need to productionise a particular product and assess capabilities of R&D organisation which could assist in the process of development.

(c) The technology for the manufacture of various electrical and electronic components like relays, push buttons, circuit breakers, terminal blocks and other need to be updated to meet increasingly stringent and sophisticated requirements.

(d) There is need for certain selected academic institutions like IITs, Indian Institute of Science equipped with adequated infrastructure to provide training to personnel in various facets of control and instrumentation.

(e) The facilities existing with certifying agencies require in-depth evaluation, and if necessary, be updated so as to provide certification work for instrinsic safety on the same lines as FM, BASEFA, etc. Electonic Research and Testing Laboratories (ERTLs) under Department of Electronics can be updated to evaluate the performance and design parameters of indigenous products.

(f) The consultants require to focus more attention to the formulation of specifications and provide suitable assistance to indigenous manfacturers.