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MICROPROCESSOR APPLICATION ENGINEERING PROGRAMME

DP/IND/84/030

INDIA

Technical report: Proposals for future UNIDO, UNDP assistance*

Prepared for the Government of India
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

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United Nations Industrial Development Organization
Vienna

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MICROPROCESSOR APPLICATON ENGINEERING PROGRAMME

DP/IND/84/030/11-05/31.9.E.

Review of Hardware and Software Projects at Various Centres. Impart training to Centres and Industries on Design ethodology.

ABSTRACT

This report describes a threefold programme of project evaluation, training lectures and assessment of future potential project activitites.

The itinery included visits to M.A.E.P centres in Delhi, Ranchi, Pune and Bangalore, together with visits to industrial organisations in Bhilai, Pune, Bangalore and Hyderabad.

The main conclusions reached from this mission were that the M.A.E.P. programme is at a stage where more system engineering projects are recommended, with the consequent need for expertise to be developed in project management of multi - disciplined fields of application of microprocessors.

Major projects in the field of application of computers to design and manufacture were identified, which may be the subjects of follow up applications to UNIDO/UNDP for assistance.

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1. INTRODUCTION

The objectives of the mission as detailed in Job Description DP/IND/84/030/11-05/31.9.E included the following tasks for the Expert:

1.1 Appraise himself on the current status of microprocessor applicaitons in the Indian Industry.

1.2 Appraise himself witn the objectives, status and the results of the various system engineering development projects going on in various centres.

1.3 To help the project personnel in hardware and software development projects going on in various centres.

1.4 To impart training to project personnel as well as centres on new methodologies for microprocessor based system engineering projects.

The expert was also expected to prepare a final report, setting out the findings of the mission and recommendations to the government on further action which might be taken.

The programme of work was to be carried out during the months of May and June 1987, as detailed in Appendix I "Itinery" including two days debriefing in Vienna and associated travel time to New Delhi.

This report is divided into sections, one for each of the M.A.E.P. centres. Conclusions relating to the activities for each centre are included at the end of each section.

2. RECOMMENDATIONS.

The M.A.E.P. activities to date are succeeding in promoting awareness of the benefits of microprocessor applications in various industries at component level. Several developments arising from this programme now warrant special attention at system/management level :-

2.1. There is a need for projects combining multi-disciplined activities such as sensors, interfacing, microprocessors and output actuators, to provide a background against which system engineering and project management disciplines may be developed.

2.2. Since a microprocessor accounts for only 30 % of a typical system, more attention should now be directed towards intelligent sensor developments. The lack of an indigenous sensor industry in India in seen to be a serious constraint to the rapid application of control systems in the near future, because of dependance on uncertain foreign suppliers.

2.3. Experts are required in Ranchi and Pune centres to assist in system engineering and project management disciplines. UNIDO assistance is required.

2.4. Major projects in the field of computer aided manufacture have been defined which could be a logical extension of UNIDO/UNDP Projects in the fields of computer aided design/manufacture and computer aided management. A national project incorporating an FMS facility for "hands on" industrial training is now proposed as a means of integrating facilities where the infrastructure already exists for training technical and managerial specialists.

2.5 Further projects in advanced manufacturing technology for precision mechanical components and automatic assembly of thick film circuits are currently being planned which may require UNIDO/UNDP assistance.

2.6 The CAD, L.S.I. facility developed in Bangalore centre should be extended to other M.A.E.P. centres. Consideration to the development of custom designed displays for system monitoring should be included for a future work programme extension requiring UNIDO/UNP assistance.

3. ACTIVITIES OF THE EXPERT DURING HIS MISSION

Following a briefing from Dr. M.K. Hussein at UNDP on arrival, the Chief Project Co-ordinator Dr. Krishna Kant outlined the itinery for visits planned, for the Regional Centre at Ranchi, Pune and Bangalore, in order to implement the required objectives of the mission.

Three main fields of activity required inputs from the Expert.

3.1 Training Lectures

Compile eight technical papers for presentation at professional institutions and companies in Bangalore, Hyderabad and Delhi. The lecture programmes are summarised in Appendix-IV " Summary of Lectures."

3.2 M.A.E.P. project reviews

Review of project work at each centre. Detailed assessment of technical problems and recommendations for problem solving. Proposals for future development projects.

3.3. Proposals for Computer Integrated Manufacture

Assessment of capability at H.M.T., C.M.T.I and I.T.I Bangalore, BHEL at Hyderabad, for proposed factory automation projects under consideration by CAD group. This activity to follow up a meeting chaired by Dr. N. Seshagiri, Additional Secretary for GOVT. of India Department of Electronics on March 13th and reported by the author in Technical Report DP/IND/84/030/11-02/31.9.E. March 1987.

4. REGIONAL CENTRE RANCHI

4.1. General

The M.A.E.P. centre is based in the Rand D division of the Steel Authority of India. The research facilities at Ranchi are at an advanced stage with separate laboratories for circuit development and prototype assembly, together with computing facilities for software development. Current work is centred on the installation of equipment for the small batch manufacture and testing of printed circuit boards and a computer technical complex involving a maximum of 42 work stations. A large technical library occupies one floor of the RD building.

The RD organisation comprises four main specialist groups :

- Power electronics including drives and controls.
- Hardware, Computer interfacing
- Software, process control on-line applications
- Computing centre, EDP

Thus a project team might be formed from engineers from the four main groups,headed by an MAEP project engineer.

4.2. Project Reviews

The main projects in hand at the present time are :

- Blooming Mill supervisory system with provision for automation of the screw down rolls.
- Moisture control in blast furnace coke charge involving measurement of moisture content on line by nucleonic guage. This project has completed simulation stage and awaits installation of the nucleonic gauge, presently planned for May.
- Automation of Tandem Mill involving control of tensioning guaging and operating parameters. A proposed system is under evaluations.

The Blooming Mill project was considered to be the largest and most ambitious undertaken to date and the author requested access to the Bhilai plant to assess progress first hand. This was duly arranged between 5th and 7th May.

4.3 Main Findings

4.3.1 Bhilai Steel Mill.

Bhilai is 130KM by road plus 617KM by rail from Ranchi and a round trip, including 8 hours at the plant, takes 48 hours. Such journeys inevitably add to the physical burden of project personnel and impede progress.

The installation was studied in detail and the following progress was noted :

- All sensors are mounted and wired
- Cables to control room installed
- Ducting for future system expansion installed
- Interfacing to computer complete on all sensors
- Data General Computer supplemented by Intel microprocessor for data acquisition
- It was concluded that the system was 90-95% complete, the main item remaining being the provision of a V.D.U. in the operator control room.

4.3.2 Bhilai Steel Miil - Development Programme.

A programme was compiled following discussion with the project team.

The main proposed change to the development programme following discussions in Delhi in March, was to use a separate microprocessor for data acquisition, retaining a Data General MP200 computer for look up tables, house keeping etc. The salient milestones were agreed on return to Ranchi on 8th May and these, together with a "Programme for Workshop on Blooming Mill Automation" which was subsequently held on Saturday 20th June at Bhilai, are included in Appendix II.

An interim progress review and presentation following satisfactory print out of sensor data proposed by the author, was made to personnel at Bhilai. The overall effect of the use of a supplementary microprocessor for data acquisistion which formed the core of the screw down automation project, was to simplify the task of writing software formerly required by the general purpose system based on the Data General Computer. It was accepted however that further software would be required when automation of the second phase of the mill is carried out and resources for this may need to be supplemented.

The relatively long time scale for this project was analysed and by far the longest delays were incurred by contractors not delivering on time or to specification, coupled with the long periods required to process orders through the

organisation. These factors increased the burden on the Project Engineer. The author discussed the need for a Project Manager with skills in purchasing and expediting to supplement the role of the project engineer responsible for system design. It was noted that such experience on system engineering was lacking, in particular skills required for implementation of major systems of the type under development.

4.3.3 Training

There have been five training programmes to date and a total of 126 engineers have attended a one week course in microprocessor applications with "hands on" experience based on Intel Kits covering basic architecture, interfacing etc. Certificates were issued on completion of the course.

4.4. Conclusions and Recommendations for Activities at Ranchi.

As a conclusion to this visit to Ranchi, the following constraints are identified which limit future development and growth in the area of automation system :

4.4.1 Process control system are multi-disciplined and experience is severely lacking in project management and systems engineering. A parallel problem is the rapidly changing scene in computer controlled system engineering.

4.4.2 The most pressing need identified is for assistance in acquiring system engineering expertise by the loan of project managers/experts with in depth experience in the design and implementation of complex system. Such experts would be required to undertake full responsibility for the conduct of the work and be personally involved at component level if necessary. Regular visits by part time UNDP consultants would enable technology to be up-dated on a formal basis. The need for a personal committment on the part of the expert for the duration of the project was strongly stressed by the chief project co-ordinator.

5. REGIONAL CENTRE PUNE

5.1. General

The facilities at Pune occupy two main laboratories with workshop facilities in the College of Engineering. There are plans to house MAEP activities in a new building which is presently being planned.

There are six projects currently listed:

- Electrocardiogram analysis system.
- Pollution monitoring system for vehicle exhaust.
- Patient monitoring system.
- Relay parameter testing.
- Blood count monitor.
- Automatic Test Equipment.

5.2. Project Reviews

5.2.1. E.C.G. Analysis

This system comprises three subsystems for data capture ECG recognition and waveform boundary indication. Work has been completed on an ECG simulator for representing normal ECG pattern, and tests are imminent. These will be followed by live trials using patient recorded data. The technology involved is latest state of the art mathematical analysis for waveform definition and advanced filtering techniques for completing the analysis.

5.2.2. Pollution Monitoring System

Present pollution monitoring equipment tends to be bulky, imobile and requiring mains operation. The purpose of this project is to devise a portable system which can be manufactured at low cost. The proposed equipment comprises a chamber into which a cooled exhaust sample is fed, a filtration element, solid state sensor and microprocessor for interpreting the output of the sensor and controlling the sequence of operation. The electronics is now designed and delivery of component parts is awaited. Parallel activity is now required on the physical packaging of the sampling equipment.

5.2.3 Patient Monitoring System

Present monitoring systems comprise a number of separate instruments for measuring heart rate, respiration rate, temperature, blood pressure (systolic and dystolic). The purpose of this project is to use one common data collection system fed from bead type transducers for measuring temperature and pressure. The electronics has been schemed out and a technique for separating systolic and dystolic pressure, but progress is hampered

for lack of components and transducers which have to be imported.

5.2.4 Relay Parameter Testing

This equipment is being developed for testing conventional electromagnetic and reed relays. The main criteria are:

- Pull in drop out, voltage
- Operate lag, release lag.
- Contact resistance

The range of operating voltages is typically 5 to 50 volts. The equipment is presently at the prototype breadboard stage based on available microprocessor kits. Work is required to package the hardware for production use.

5.2.5 Blood Count Monitor

This project was designed but not proceded with because of problems of obtaining suitable sensors.

5.2.6 Automatic Test Equipment

This is a new project aimed at a general purpose equipment design suitable for checking printed circuit board assemblies. The author proposed that as a first step, a market survey should be conducted in Europe to establish the configuration that would satisfy the most likely applications in terms of volume, interconnections, number of test points, type of print out/display etcetera.

5.3. Notes on Instrument Industry in Pune

It was arranged for the author to visit a company designing and manufacturing range of electronic process instruments and systems such as temperature controllers, Proportional-Integral-Derivative controllers, data acquisition systems and "Smart" sensor interface modules for networking with microprocessors. The company employed eighty people with a turnover of approximately one crores. The director of the company also founded the Pune Institute of Computer Technology which offered a four year course culminating in a degree awarded by the College of Engineering. Projects undertaken by graduates were advanced state of the art and included computer aided design of circuit layouts, simulation of process plant and translation modules and software for interfacing different personal computers such as Apple and IBM pc to a common network. Approximately sixty graduates were being trained and a new college is under construction with capacity for 1000 pupils.

5.4. Main Findings.

5.4.1.Overview

The above projects represent a mixed cross-section of microprocessor application for electro medical and process analysis applications but are confined to specialist purpose, instrument type applications.

Without exception, progress on all projects was good in so far as technical design and competence was concerned, but delayed by administration procedures for purchased items.

Guidance is required on project management techniques for implementation of fully engineered equipment.

Staff shortages limit more ambitious projects from being undertaken. There are vacancies for:

Requirements	Target
- One Principal Systems Engineer	1
- Two Senior Project Engineer	3
- Two Junior Project Engineer	4
- Three Experimental Assistants	4

It was felt that the government salary scales do not match comparative grades in industry and the outcome of the present recruitment compaign was problematical.

Courses are being conducted on microprocessor application, based on" hands on" training and the staff are well versed in latest software programmes for specific applications.

5.4.2 Component and Sensor shortages

These pose a real problem for project implementation. The problem will get worse as more ambitious projects are undertaken. Any process is critically dependant on the sensors used for measurement Experience to date in attempting to purchase these from established foreign suppliers has met with no success. It is necessary therefore to promote the development of arange of sensors. Such a development programme may prove to be as big an undertaking as the MAEP programme required to promote basic microprocessor applications.

5.4.3 Project Administration

As an introduction to the need for more sophisticated management aids for project systems engineering referred to above, a formal layout for project specifications was proposed by the author and included in Appendix III. The

purpose was to provide a unified approach to specifying the objectives of a project, operational requirements, mechanical and electrical design and environmental aspects. Finally a development programme for charting progress and a list of materials required. Thus when a project is completed, a complete project document would accompany the prototype for production. The proposed documentation provides an ongoing check list to enable project engineers and supervision to gauge the progress at any instant, in time and take the appropriate action. From subsequent discussion held with Dr.Krishna Kant, Chief Coordinator, the proposed documentation is to be adopted. by MAEP.

5.4.4 Future developments

Emphasis to-date has been directed towards basic training in the design and application of microprocessors and their attendant range of software to suit particular application. Plans are in hand for extended training by gaining field experience of systems applications in industrial and scientific organisations. Projects to date have been special purpose, instruments oriented. If this trend is to be developed and more ambitious projects such as process analysis are to be undertaken for example, the basic skills already acquired in the use of microprocessors for control and analysis will need to be supplemented by similar skills in instrument design, electro-mechanical packaging, industrial styling and human factors such as operator controls. The task of identifying and recruiting personnel with such skills is a formidable one even by western standards, thus a solution might be sought in joint venture collaborative deals with industrial partners. This approach will still require experienced project managers to coordinate such projects, an area where UNDP may be able to assist with part-time experts. From the experience gained on current projects, two project activities are proposed which extent the role of MAEP at Pune.

- Energy conservation. Battery plus solar powered prime mover for domestic power and commuter vehicles. This will initially involve computer simulation of the dynamics of a particular configuration, characteristics of alternative power sources and assessment of the effect of duty cycle on stored energy devices.

- Process analysers. This will provide a logical extension of work already in hand in patient monitoring, exhaust monitoring and supplement the work carried out by MAEP on process instrumentation elsewhere. Process analysers are heavily dependant on microprocessor technology for control of the sampling process and processing of signal data and represent examples of high added value products.

5.5. Conclusions and Recommendations for Activities at Pune

5.5.1 Without exception, all projects currently undertaken at Pune (and other) MAEP Centres, suffered because of problems associated with the supply of components and sensors.

5.5.2 Pilot plants for custom designed displays should be considered in areas where high technology instruments and control systems are being developed to speed up the response time for the manufacture of these key items.

5.5.3 Assistance is required from UNIDO/UNDP Project engineers/experts to guide the implementation of projects. They are required on a part time basis.

6. REGIONAL CENTRE BANGALORE

6.1. General

Activities at Bangalore were divided between three projects

- Preparation and delivery of four technical lectures

- Review of M.A.E.P. projects and participation in discussions for future projects.

- Discussions with Hindustani Machine Tools. Central Machine Tool Institute and Indian Telephone Industries on the feasibility of implementing a Fiexible Manufacturing System.These discussions are reviewed under section 8 "Proposals for Automation Projects."

6.2. Lectures

Lectures were presented by the author to the Institute of Electrical and Electronics Engineers,I.T.I and N.A.L, on the following topics:

- Intelligent sensors and Process Automation

- Practical Aspects of Computers and Communications systems in process Control and Manufacturing Automation.

- Distributed computer systems for Hierechial Data Collection and manufacturing management.

Summaries of these lectures are included in appendix IV.

6.3. REVIEW OF M.A.E.P. Projects

Activities under this review were grouped in two phases, progress during 1986-87 and proposed projects for 1987-1988. The activities of this Centre during 1986-1987 were mainly concerned with the continuation of the 4 developmental projects identified at the time of estabilshing the Centre, and the building up of the infrastructural facilities needed to provide a unique identity to the centre and support direct development projects and man-power development programmes. The following sections summarise the progress made in each of these directions.

6.4.Main Findings

The following four developmental projects which were initiated right at the commencement of the Centre, have registered substantial progress and have reached a near completion stage:

--- Design and development of an intelligent controller for satellite data communication network.

--- Fail safe controller for Electronic Switching systems employing redundant processors.

--- Microprocessor based C.A.D. system for L.S.I.circuits.

--- Microprocessor based modular units for telemetry and telecontrol, with remote diagnostic facilities.

All these projects were carried out with almost exclusive support by the regular staff of the ITI R&D division.

6.4.1. Design and development of an intelligent controller for satellite data communication network.

Hardware development of central station is complete. This consists of parallel/serial interface card, codec controller card, CPU CARD, PC-CPU interface. All the display and key-board at central station have been completed. Hardware development of remote station is also complete. The operator display and key pad at remote station has been completed. Software at remote station is nearing completion. Software at central is being developed. The integration and testing of full system is proposed in the month kof August 1987.

6.4.2 Fail safe controller for electronic switching systems employing redundant processors.

This project envisaged the development of a failsafe controller for electronic switching systems, using dual microprocessors.

An additional intelligent unit is needed to decide as to which one of the units will be in 'on line' and the other as 'standby' or off line. The various functions of the intelligent controller are :

--- Detection of fault

--- Identifying the faulty unit

--- Switching good unit on-line and faulty unit to off- line modes, without affecting the continuity of the services.

--- Restoring normalcy after rectification of the faulty unit.

With the assistance of the MAEP CENTRE , this project has been successfully completed, yielding a fund of technological know-how on the redundant processor based controller for providing reliable operation of the controlled system.

As a practical application of this know-how, a dual microprocessor based controller has been incorporated in to the ILT exchange developed by ITI (R&D), which has successfully undergone extensive field trials.

6.4.3 Microprocessor based cad system for L.S.I circuits.

The software package for Computer Aided Design of standard cell design LSI's on the OMEGA 58000 has been completed and tested. Sample circuits have been satisfactorily processed from masks made on this facility. For better cost-effective system configurations, involving a host processor PC based multiple workstations, the work of splitting the non-graphics and graphics modules between the SUPER STAR micro computer based system and the IBM PC/AT compatible graphic work-stations respectively, is under progress.

Further computer facilities from MAEP are not envisaged for this project. The host-workstation configuration of this CAD package is expected to become fully operational by June, 1987.

6.4.4 Microprocessor based modular units for telemetry and telecontrol, with remote diagnostic facilities.

The above project involves development of IBUS compatible hardware modules with features permitting testability both on line and off line, as well as diagnostic software.

Of the proposed hardware development, seventy percent of the paper designs are completed and are in various stages of prototyping. The balance are under design. The modules for which the paper designs are completed are digital output card, digital input card, serial I/O intertace card and single card modem. Various test programmes have been developed. The specifications for human interace package and communication protocols are under preparation.

The tentative target for demonstration of fully tested prototype is December, 1987.

6.4.5 Training Fellowships

Under the Training Fellowship programme of the UNDP extended for this Centre, two engineers were deputed to the Department of Electronics, Process Control and Electrotechnik, at the University of Bremen, Bremen, West Germany, for a period of 3 months from 16th Feb. to 15th May 1987. During their visit they first had in depth studies on a Token Bus Controller (TBC) system for Local Area Network, studied an online real time control

software package called INSTAL ON THE KATCE computer system based on Motorola 68000 microprocessor and visited the International Trade Fair for Computers at Hannover in March '87, where they were able to get acquainted with several new products in the areas of PC system, office Automation, Industrial Robotics and Fibre Optics based communication systems.

6.4.6 Building up of infrastructural facilities.

During the year 86-87, significant progress was mode with regard to the recruitment of staff, creating a separate building for the centre to give it a unique identity and procurement of a set of major equipment for supporting active developmental work. A total of five engineers and five support staff have been recruited.

6.5 Future Developments.

The activities of the SRC for MAEP during 1987-88 are planned along the following lines:

--- Continuation of the four on-going projects to their completion during 1987-88.

--- Commencement of three new projects.

--- Training programmes and seminars.

The first of these activities is a logical extension of the efforts already put in by the centre, based on the support received by the staff of ITI (R&D), and to see that they are carried out to their successful completion as planned, during 1987-88. The second proposal is aimed at taking the Centre to a more mature level, with an integrated objective of fostering developments in the Data Communication area, and is based upon the infrastructure being built up. The last activity is in keeping the other objective of the MAEP. The following proposals for new projects are being considered.

6.5.1 Intelligent Data Multiplexer/Demultiplexer

The objective of this project is the development of a Data Multiplexer/Demultiplexer (DMD) equipment, to enable full duplex data communication between up to 8 pairs of asynchronous ports via a single high speed synchronous link. The DMD is to be provided with appropriate automatic error detection and recovery features, by means of a microprocessor, which will form the central element of this unit

6.5.2 Local area network module for engineering design environment

Local Area Networks (LAN's) are becoming increasingly popular as a means for inter connecting a boad variety of data handling devices within a moderate geographical area. The current

trend in networking is to use an "open system" approach based on recognised standards, which allows the end user to purchase equipment from several vendors in order to realise the most cost effective solution for a given application.

The main objective of this is to develop a compatible set of modules, based on microprocessors and related devices for realising a Local Area Network, linking computer systems using some of the most popular microprocessors. It is proposed to develop these modules conforming to IEEE 802.4 standards for Token bus which also makes it possible to add/remove nodes, without interrupting the network service.

6.5.3 Knowledge-base shell for communication network envornment.

Expert systems are by far the most commercially successful form of AI (Artifical Intelligence) software. They are already used by a host of industries, principally in the areas of manufacturing, equipment maintenance computers.

Expert system technology is most appropriate for applications that resist conventional solutions, for problem areas that change rapidly and are ill-defined or unbounded, and for problems that human experts are currently solving laboriously or expensively.

The proposal is for building a knowledge base shell usable on IBM PC Compatibles, which can be used even by first time users to develop knowledge based consultation systems. The knowledge base shell can be thought of as a combination of relational database and an inference engine; the combination being achieved by some form of logic programming, possible with access to a conventional database. In a relational database, facts are stored in tables (so far as the user is concerned) and compound facts can be retrieved from more than one table by noting that the tables have common entries.

The shell will be flexible in integrating new incremental knowledge into the existing store of knowledge. It can show knowledge in a comprehensible form. It answers questions by using its knowledge and it provides explanations of its answers.

Such a generalised knowledge base shell can be readily appled for the following functions in a typical telecommunicaton systems service/manufacturing applicaiton.

- Network planning and feasibility studies
- Operator Assistance
- Network Monitoring
- Fault Diagnosis
- Resource Management

6.5.4 Training courses/seminars

During the year 1987-88, the following courses and technical seminars, all devoted to the theme of "Applications of Microprocessors in Communication Systems" are proposed:

1) Intensive course on "Microprocessors and Communication Systems" for working engineers in Indian telecom. systems.

2) Awareness Seminar on "Microprocessors in Telecommunication Systems" for senior management personnel.

3) National Seminar on "Applications of Microprocessors in Modern Communication systems"

4) Intensive Course on "Microprocessors and Communicaton Systems" for working engineers from developing countries

5) Seminar on "Advanced Microprocessor Architecture".

6.5.5 Training Fellowships

It is proposed to depute four engineers for a three month training programme during October, November and December, 1987, in the following specific fields:

1) Data Communications via Satellities.

2) Digital Switching Systems.

3) Local Area Networks.

4)Digital Data Transmission Systems.

Efforts are underway to locate and obtain the acceptance of relevant universities and industrial R&D units.

6.6.Conclusions and Recommendations for Activities at Bangalore

In view of the specific new projects proposed to be undertaken in the SRC-MAEP, it is proposed to utilize the services of two experts from developed countries, one each in the areas of "Artificial Intelligence Applications" and "Local Area Networks."

It is envisaged that the availability of two UNIDO experts would greatly enhance the quality of the technical activities of the centre.

7. PROPOSALS FOR AUTOMATION PROJECTS

7.1 Activities

Activity of the author was directed towards preparation of proposals for National FMS/CIM Centres in colaboration with Dr. A. Cameron, CAD group. In broad terms it was decided to formulate a national strategy in which overall direction, policy and funding should emanate from a central co-ordinating centre at NIC Delhi, with specialist centres responsible for execution of the proposed FMS/CIM programme, some of which already exist :

- FMS/CIM National Project Centre at HMT-Bangalore. Setting up pilot factory for demonstrating physical aspects of FMS. New Project seeking UNDP assistance.

- CAD/CAM Centre at CMTI Bangalore. Application of existing UNDP funded facility for design and computer aided engineering/production of a range of representative components manufactured by industry.

- FMS/CIM Centre at I.I.T. Kharagpur. Development of Robotics, AGV'S, automated handling systems and software for integrating such systems with FMS, New project.

- Computer Aided Management, UNDP programme started in 1983 jointly with D.O.E. to improve management techniques using computer aids. To be focussed towards industry management, production management, project planning etc. Four centres are established.

7.2 Visits

The following visits were planned for the author by CAD group in connection with proposals for factory automation, initiated by Dr.Seshagiri, Addl.Secretary, on Friday 13th March.

Central Machine Tool Institute	Bangalore - 2 visits.
Hindustan Machine Tools	Bangalore - 3 visits.
Indian Telephone Industries	Bangalore - 1 visit

Hindustan Machine Tools(Factory)	Hyderabad - 1 visit
Bharat Heavy Electricals Ltd	Bangalore - 2 visits

In addition, the author met the Chairman of H.M.T., Mr.M.R.Naidu at the request of Dr.H.K.Hussein, SIDFA to discuss the possible role of HMT in future automated manufacturing projects.

Following visits and discussions with senior executives of the above companies, three specific projects requiring the application of AMT (Advanced Manufacturing Technology) were identified which would require specialist input from UNIDO & UNDP;

- National project to introduce FMS within various enterprises. Management training, design and implementation of pilot plants to reduce floor to floor time and improve quality.

- Application of AMT for the design and manufacture of turbine blades including design, machining, finishing and automated inspection of a range of turbine blades, using latest computerized production technology.

- Automated plant for the manufactures of thick film circuits for custom designed applications. To include all actives from CAD to assembly and test.

7.3 National Project to introduce FMS

This project is the subject of a project proposal (Concept) elaborated by representatives of participating countries in "Technical Working group on production and use of Machine Tools" Singapore 17-21 November 1986.

Following the visits and subsequent discussions by the author, elaboration of the proposal is in hand to include the participation of the following organisations,described in Appendix-V`

CMTI- with particular reference to the role of UNDP-CAD centre.

HMT- with particular reference to overall project installation and demonstration

ITI- with particular reference to networking computers and system communications.

UNIDO- specialist inputs in technology and project management.

The proposed project is intended to provide a demonstration and training facility the widest possible range of parts machined in industry. For example, cubic components up to half cubic metre, turned shafts and gears up to 200mm diameter by 500mm long and flanged components up to 500mm diameter by 150mm long. From published statistics, this range of components will typically account for 85% of all machined parts made. A typical application will accur in the case of the automobile industry which represents the largest potential market.

It is proposed to implement the project in a systematic manner by progressive development of machining systems and their attendant computer based sub-systems.

The project is to be divided into three phases, which are to be the subject of submissions to UNIDO/UNDP for assistance :

Phase 1

Creation of primary FMS cell for the manufacture of cubic components. Development of computer aids necessary to input data to the cell from customer inquiry and design to finished manufacture and inspection.

Phase 2

Addition of a secondary FMS cell for the manufacture of disc type components such as bearing covers, gearbox covers etcetera. To be linked with central computer sub-systems developed in Phase 1.

Phase 3

Addition of a third FMS cell for the manufacture of shafts, gears and miscellaneous turned components. To be linked with central computer sub-systems developed in Phase 1.

7.4 Application of A.M.T. to turbine blade design and manufacture at BHEL Hyderabad.

Notes of this visit are appended in Appendix VI.

This project was identified as being crucial to the restructuring of the production area for blade manufacture at BHEL for volumes of 150,000 blades per annum. A proposal for consideration by UNIDO/UNDP may be submitted.

APPENDIX I
ITINERY - E.J. WIGHTMAN

29 April - 24 June 1987

Date	Time	Activity
		Arrive N. Delhi.
Wed 29/4/87	10 a.m.	U.N.D.P-Dr.M.K. Hussein Breifing.
	2.30 p.m.	M.A.E.P - Dr.Krishna Kant Chief Project Co-ordinator with Mr. S. Rajaram, Deputy General Manager Project Co-ordinator M.A.E.P Indian Telephone Industries Bangalore, Itinery for visit to I.T.I.
Thu 30/4/87	10 a.m.	Dr. B.K. Gairola Additional Director and Dr. A. Cameron System Analyst, Design Automation Group to discuss FMS project and itinery for visit to H.M.T., C.M.I.T and B.H.E.L.
Fri 1/5/87	2.0 p.m.	UNDP - Dr M.K. Hussein reference request by Chairman of HMT to visit.
Mon 4/5/87	4. a.m.	Depart for Ranchi,
	9.30 a.m.	Dr. J.Battacharya Project Co-ordinator M.A.E.P., Dr.B.Puthal Research Manager Mr. N. Neogi - Asst.Research Manager, Power Electronics.
Tue 5/5/87	11.30a.m.	Dr.S.K.Gupta - Director Group R&D centre for S.A.I.L.
	1 p.m.	Depart for Bhilai Steel works
Wed 6/5/87	6.30 a.m.	Arrive Bhilai
	9.30 a.m.	Arrive Steel Works Mr M.P. Jasuja - P.C. and in charge Mr. Krishnan Manager(Electrical) Blooming and Billet Mill Mr. R.K. Saighal - Chief Supt. INCOS
	8.40 p.m.	Depart for Ranchi
Thu 7/5/87	4.00 p.m.	Arrive Ranchi
Fri 8/5/87	9.30 a.m.	Debrief with Dr. Battacharya, Dr. B. Puthal. Compile revised development programme.
	4.30 p.m.	Dr. S.K. Gupta - Director Dr. V. Ramaswamy - General Manager Final presentation for visit to Bhilai.
Sat 9/5/87	6.15 a.m.	Depart for New Delhi.
	11.00 a.m.	Arrive New Delhi.

Mon 11/5/87	8.30 a.m.	Depart for Pune.
	– 4.30 p.m.	Arrive Pune M.A.E.P. - Prof. A.M. Dhake Chief Co-ordinator Mr. H. Pathak Senior Project Engineer
Tue 12/5/87	11. a.m.	Project Reviews
Wed 13/5/87		Compile draft report.
Thu 14/5/87	10. a.m.	Project reviews. Tour of Engineering College
Fri 15/5/87	8.45 a.m.	Visit Lektrotek instrument company -
Sat 16/5/87		Mr. N. Ramakrishna Director
	12 a.m.	Prof.H.V. Adavi, Principal College of Engineering Recommendations for future actions.
Mon 18/5/87	5.45 a.m.	Depart for Bangalore
	1.30 p.m.	I.T.I Mr.S. Rajaram
Tue 19/5/87		Itinery for lectures and meetings
Wed 20/5/87		Prepare lectures.
Thu 21/5/87	11. a.m.	Mr. G.V. Appa Rao Director Machine Tools HMT Dr. N.R. Mautena General Manager Mr. M.T. Reuben, Dy. Chief Engineer Technology Mr. S.K. Sood Joint General Manager R & D
	2. p.m.	Mr M.N. Murching Director Mr. S. Vasantha Kumar, National Project Director, Central Machine Tool Institute
Fri 22/5/87	9.00 a.m.	I.T.I Mr. S. Rajaram M.A.E.P. Projects.
Mon 25/5/87	9.00 a.m.	H.M.T cnc systems developments and Factory Automation Projects.
Tue 26/5/87	9. a.m.	I.T.I Lecture notes.
Wed 27/5/87	2. p.m.	I.T.I T.A.C. meeting - Dr. Krishna Kant - Prof. Dhake - Mr. S. Rajaram
Thu 28/5/87	9. a.m.	C.M.T.I Dr. Vasantha Kumar FMS, C.I.M project.
	6.00 a.m.	Lectures I.E.E. Smart sensors in process control."
Fri 29/5/87	11. a.m.	I.T.I. Dr. Prabhakar general Manager L.S.I. activities.
Mon 1/6/87	10.a.m.	National Aeronautic Laboratory.
	2. p.m.	H.M.T Dr Appa Rao, F.M.S., C.I.M. project.

	4.p.m.	Tool Craft Mr.P.R. Shivasnankar.
	6.p.m.	Lecture I.E.E."Computers and Communications in Process Factory Automation."
Tue 2/6/87	9.a.m.	I.T.I M.A.E.P. Projects
	3.p.m.	Lecture to I.T.I Management. "Distributed Computer Systems for Hierchial Data Collection and Manufacturing Management."
Wed 3/6/87	9.a.m.	I.T.I. Mr. M.S. Jayasimha, Director EDR(D).
	2.p.m.	H M T Mr M.R. Naidu - Chairman & M.D.- F.M.S and C.I.M project.
	5.p.m.	Depart for Hyderabad.
Thu 4/6/87	9.a.m.	BHEL - Mr C.K. Khot General Manager. - Ranjit Mathew Snr. Manager Manufacturing sevices. - V.Mangaleswaran Dy. General Manager - Y -Nagarajuna Rao Manager Technology Dev. Lab.
Fri 5/6/87	10.a.m.	BHEL - Lecture -FMS Applications
	2.p.m.	- Meeting -Advanced Manufacturing Technology - Blade Manufacture.
Sat 6/6/87	5.30 a.m.	Depart for Delhi.
Mon 7/6/87	9. a.m.	MAEP - Dr.Krishna Kant
	2. p.m.	Dr. Cameron - CAD Group.
Tue 8/6/87 } Fri 11/6/87 }		Proposal for National FMS/CIM Project.
Mon 14/6/87		Prepare final report.
Tue 15/6/87	4.p.m.	College of Engineering N.Delhi Prof. Mandal - Principal Prof. Murthy - Dept. Elec. Eng. Lecture "Principles of Computer Aided Manufacture."
Wed 16/6/87	12.a.m.	Dr. Gairola, Dr. Cameron. Review of FMS/CIM proposals
	2.p.m.	UNDP - Dr. M.K. Hussein Review of future projects - FMS/C.I.M.
Thu 17/6/87		Prepare final report
Fri 18/6/87	9.30 a.m.	Depart for Bhilai
	2.15 p.m.	Arrive Bhilai
Sat 19/6/87	9.45 a.m.	Lecture - Trends in Computerised Process Control.

	12.40 a.m.	Lecture - Screw Down Control - An Overview.
Sun 20/6/87	12.30 a.m.	Depart for N. Delhi.
Mon 21/6/87	2.00 p.m.	UNDP - Dr. M.K.Hussein project review Complete final report.
Tue 22/6/87	10.30 p.m.	Depart for Vienna.

APPENDIX-II

BLOOMING MILL AUTOMATION PROJECT

Proposed schedule for Datalogging and Screw - down Control with existing drive system.

		From	To
Phase-I	**Datalogging**		
1.	Print out of sensor data		8th June'87
2.	Progress review and presentation of work done (at Bhilai)	15th June, 1987	18th June, 1987
3.	Finalisation of computer architecture vis-a-vis MP200 & 8086 microcomputers	18th June, 1987	6th July, 1987
4.	Validation of datalogging	6th July, 1987	End August 1987
Phase-II	**Screwdown control with existing drive system**		
1.	Mounting of VDU at Pulpit 2		End July, 1987
2.	Comparative analysis between simulated computer control and actual manual control by operator for screw down.	Sept. '87	Oct., 87
3.	Review of system configuration and modification		Nov., 87
4.	Supervisory mode of operation through computer for screw down.		Dec.' 87
5.	Auto mode operation of screw down with computer.	Dec.'87	Jan.; 88
6.	Project review, conclusions and recommendations.		Feb.' 88

PROGRAMME FOR WORKSHOP ON BLOOMING MILL AUTOMATION

DATE : 20 TH JUNE 1987

VENUE : ISPAT BHAWAN CONFERENCE HALL

I N A U G U R A L S E S S I O N

1.	Welcome	: Shri R.K.Saihgal CS(INCOS)	9.30 - 9.35 hrs
2.	Introduction	: Dr. J.Bhattacharya PC (A&CS) (RDCIS)	9.35 - 9.45 hrs
3.	Modern Trends in Computerised Process Control	: Mr. E.J.Wightman, UNDP Expert	9.45 - 10.15 hrs
4.	Address by Chief Guest	: Shri B.V.Kudva ED (Works), BSP	10.15 - 10.30 hrs
5.	Vote of Thanks	: Shri N.Neogi PRE (RDCIS)	10.30 - 10.35 hrs

T E A B R E A K 10.35 - 11.00

T E C H N I C A L S E S S I O N

1.	Introduction & objectives	: Dr. J.Bhattacharya PC (A&CS) (RDCIS)	11.00 - 11.20 hrs
2.	Requirement of Rolling process	: Shri P.C.Chakraborty C.S.(BBM)	11.20- 11.40 hrs
3.	System Design and Hardware status	: Shri N.Neogi, P.R.E.(RDCIS)	11.40 - 12.00 hrs
4.	Software configuration and status	: Dr. B.Puthal P.R.M.(RDCIS)	12.00 - 12.20 hrs
5.	INCOS Project & Blooming Mill Main Stand Automation.	: Shri R.K.Saihgal C.S.(INCOS)	12.20 - 12.40 hrs
6.	Screw down control - An over view	: Mr. E.J.Wightman, UNDP Expert	12.40 - 13.10 hrs
7.	DISCUSSION	:	13.10 - 13.30 hrs

L U N C H 13.30 - 14.30 hrs

S I T E V I S I T

8.	Demonstration of the system at Blooming Mill	: Shri N.Neogi, P.R.E.(RDCIS)	15.00 - 16.30 hrs

D I N N E R AT BHILAI HOTEL 20.00 - hrs

APPENDIX-III

PROJECT SPECIFICAITON-PROPOSED FORMAT

1. OBJECTIVES.
2. OPERATIONAL REQUIREMENTS
3. CONSTRUCTION
4. MECHANICAL DESIGN
5. ELECTRICAL DESIGN.
6. ENVIRONMENTAL SPECIFICATION
7. SIZE
8. WEIGHT
9. POWER SUPPLIES
10. ESTIMATED COSTS

    A) Production
    B) Sale

APPENDICES

I. Development Programme

II. Material Schedule.

APPENDIX-IV

SUMMARY OF LECTURES

1. "Intelligent Sensors and Process Automation."

   Thursday May 28 at 6.00 P.M.
   Institute of Electrical and Electronics Engineers Bangalore Section (jointly with Computer Society).

2. "Sensor Technology and the role of Microprocessors in networking Sesnsores."

   Monday June 1 at 10.00 A.M.
   National Aeronautical Laboratory, Bangalore.

3. "Practical Aspects of Computer and Communication systems in Process Automation."

   Monday June 1 at 6.00 P.M.
   Institute of Electrical and Electronic Engineers, Bangalore section (jointly with Computer Society).

4. "Distributed Computer Systems for Hierachial Data Collection and Manufacturing Management."

   Tuesday June 2 at 3.00 P.M.
   Indian Telephone Industries, Bangalore.

5. "Strategy for introducing Advanced Manufacturing Technology and FMS for Turbine Blade Production."

   Friday June 5 at 10.00 A.M.
   Bharat Heavy Electrical Limited, Hyderabad.

6. " Principles of Computer Aided Manufacturing."

   Tuesday June 16 at 4 P.M.
   College of Engineering N. Delhi.

7. "Modern Trends in Computerised Process Control."

   Saturday 9.45 a.m.
   Bhilai Steel Mill - Ispat Bhawan Conference Hall.

8. "Screw Down Control - An Overview."

   Saturday 12.40 p.m.
   Bhilai Steel Mill - Ispat Bhawan Conference Hall.

APPENDIX-V

CONFIDENTIAL

Minutes of the meeting held on 3rd june 1987 with Mr. E.J. Wightman in the Chambers of Chairman, HMT

Present

HMT	UNDP
-Sri M.R. Naidu, Chairman & MD	Mr. E.J. Wightman
-Sri G.V.Appa Rao, Director Machine Tools	
-Sri A.K. Gangopadhyay, General Manager, R & D	
-Dr. N.R. Mantena, General Manager, CSB	
-Sri M.T. Reuben, Deputy Chief Engineer, Technology, MTD	

Mr. Wightman, the UNDP expert, explained briefly his professional background and stated that he had experience in fields like microprocessor Engineering Application Programme (MEAP), CAD/CAM, FMS, CIM and had been assigned by DOE the task of preparing a proposal for Computer Integrated Manufacturing Project (CIM) which is to be set up as a Demonstration Centre in India. This Centre shall demonstrate the advantages of computer integration in the operations of a manufacturing unit right from shop floor upto office automation. The options available are to set up such a centre either in a Research Institute or in a manufacturing Unit.

HMT made it clear that though HMT, being a Public Sector Unit, has to achieve national objectives, it also has to meet commercial objectives and if the proposed centre is to be only a Demonstration Centre, CMTI would be the right place.

Mr. Wightman pointed out that his past experience had shown that such a Demonstration Centre set up in a commercial organisation like HMT rather than in a Research Institute would have more credibility.

HMT stated that it is agreeable in principle with the above concept, subject to the following conditions:

1. The proposed scheme should be technoeconomically viable.

2. The funds for setting up the Demonstration Centre are to be provided fully by UNDP/DOE.

3. The required software and management manpower can be provided by HMT. However, the necessary expertise has to be provided by UNDP, through training of HMT engineers in areas where HMT does not have the expertise.

4. The set up shall be so configured that it is suitable for automobile components, as the Automotive Industry is the most potential customer for such technology. HMT should be free to run the facility for manufacture of automotive components/any other components on commercial lines.

As suggested by Mr. Wightman HMT would be willing to work on this project in association with CMTI in the area of CAD/CAM and ITI in the field of networking and design of computer database.

(M.T. Reuben)
Deputy Chief Engineer
(Technology)

Cc: Mr. E.J. Wightman-for kind information
CMD Thru' : DMT {
DMT {- for kind information
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APPENDIX VI

Notes on Visist to Bharat Heavy Electrical Limited Hyderabad, 4th - 5th June 1987.

Objective

To discuss the possible application of FMS and robot handling systems to the manufactures of turbine blades.

Scope of visit

The visit encompassed three activities, planned by Mr.Ranjit Mathew Senior Manager, Manufacturing.

- Tour of turbine blade manufacturing plant.
- Presentation of a lecture on FMS with particular reference to interfacing the role of the design office with computer aided manufacturing.
- Discussions on proposals for restructuring the manufacturing facility.

Manufacturing Plant

The hub of manufacturing revolves around an annual throughout of a total of 150000 turbine blades per aunum, covering a range of sizes from 100mm to 500mm approximately.

The work was laid out in a conventional line manner with rows of machines allocated for specific operations, culminating in an inspection department for 100% inspection of each blade.

It was claimed that analysis had shown that out of the total floor to floor time, very little time was expended in actual machining, most was taken up in movement of parts between successive operations. Current investigation were directed towards the use of mechanical handling, robot loading systems and/or A G V systems.

Discussions

On being invited to comment on ways of improving floor to floor time, the author recommended that the first priority appeared to be a complete review of present methodology and possible re-layout of the workship to minimise the routes which components were required to follow, before considering how FMS and/ or automated conveying system might be utilised to speed up handling times.

It was proposed to investigate the application of "Cell Manufacture" by grouping machine for all operations required to make families of parts. Such cells would be capable of all rough machining, fine machining, finishing and inspection operations in one locality, for a range of blades of given sizes.

The following steps were proposed:

- Analyse the total range of blades produced to determine what natural groups may be identified.
- Divide the range between say, four or five families on the basis of length, for selection.
- List processes required for each type of blade as a further criterion for group selection.
- Examine alternative shop layouts based on a number of cells ascertained above, as distinct from the present lines of machines.
- Compile list of additional machines required, if any.
- Investigate alternative techniques for on-line inspection of components.
- Question all process planning layouts for all blades. (Some processes dated back twenty years.)

Acions

The above work plan was accepted in principle. Proposals would be formulated for review during the following two weeks. The author was asked if a return visit might be arranged to monitor the project. The question was referred for the attention of Dr.Krishna Kant, Chief Project co-ordinator MAEP.

R & D Activities

A new R & D facility was being constructed where principles of CNC machining, FMS, robot loading and AGV's could be evaluated.

Concluding Notes

This visit served yet again as a reminder that whereas capability at component level equallises the latest advances in developed countries the "Top Down" approach, whereby the strategy for the system precedes the implementation, now requires emphasising.

Those present

Mr. C.K. Khot
General Manager (Engineering and Commercial Co-ordination)

Mr. J.P.L.N. Sastry - Deputy General Manager.

Mr. V. Mangaleswaran
Deputy General Manager (Toolroom and Blade shop)

Mr. Y. Nagarjuna Rao
Manager, Technology Dev. Lab.

Mr. K. Kanakaraj
Senior Manager, Technology Dev.

Mr. Y.L.Narasinha Rao
Deputy Manager
Technology Development

Dr.K.C.B. Raja
Development Engineer

Mr. Ranjit Mathew
Senior Manager, Manufacturing Services.