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MICROPROCESSOR APPLICATION ENGINEERING PROGRAMME

DP/IND/84/030

INDIA

Technical report: Training in microprocessor applications in industrial control*

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

Based on the work of Eric J. Wightman,
expert in automation in manufacturing and process control industries

Backstopping officer: V. Smirnov, Engineering Industries Branch

United Nations Industrial Development Organization
Vienna

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MICROPROCESSOR APPLICATION ENGINEERING PROGRAMME

DP/IND/84/030/11-02/31.9.E

Training in Microprocessor Applications in Industrial Control

ABSTRACT

This report describes the preparatory work involved in delivering lectures on the subjects of Sensor Technology, Process Control Instrumentation, Computer Aided Manufacture as part of a training programme held during 2nd and 3rd April 1987 to representatives of industry and national organisations.

Arising from responses to the lectures and discussions held with senior executives of leading organisations a broad outline for future measures for promoting microprocessor applications is suggested.

Detailed action arising from preparatory work carried out during this mission are to be the subject of a follow up mission during the months of May and June 1987.

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LIST OF APPENDICES

1. INTRODUCTION

The objective of the mission as detailed in Job Description DP/IND/84/030/11-02/31.9.E included the following tasks for the Expert:

1.1 Appraise himself on the current status of Microprocessor Application in the Indian industry

1.2 Participate in training programme organised by New Delhi and other MAEP centres.

1.3 To visit a few industries as appropriate and suggest a plan of action for further development.

1.4 Suggest measures for promoting microprocessor applications in Indian industry.

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 month of March, 1987 including two days briefing in Vienna and associated travel time to New Delhi.

2. RECOMMENDATIONS

As discussed in Section 3 - "Activities" this mission was dominated by the preparation and delivery of three lectures on the subject of sensors, Process Control and Computer Aided Manufacturing (CAM) consequently limited time was available for studying individual projects in depth. Sufficient information was obtained however to plan a follow up mission embracing the following areas:

- Blooming Mill Project at Ranchi.

- Computer Control Systems for machine tools at Bangalore.

- Railway Projects.

From impressions already gained from discussions held with senior executives it is recommended that future attention should be focussed particularly towards Control System Engineering aspects of Microprocessor Applications discussed in detail in Section 6 "Future Measures for Promoting Microprocessor Applications" and relevant preparatory work should accordingly be undertaken prior to a follow-up mission planned for May/June 1987.

3. ACTIVITIES OF THE EXPERT DURING HIS MISSION

Following a briefing from Dr. M.K. Hussein UNDP on arrival, the Chief Project Co-ordinator Dr. Krishna Kant outlined the scope of the activities of the Microprocessor Application Engineering Centre, CCI Wing, Department of Electronics, A-Block, CGO Complex, Lodhi Road, New Delhi 110 003:-

Two main fields of activity required inputs from the Expert:

1. Compile three technical papers for presentation during a two day Industry/Engineering Meet to be held in New Delhi on 2nd and 3rd April, 1987. The lecture programme is included in Appendix II "Summary of Lectures" and approximately half the programme was to be contributed by the author, the remainder by Dr. Krishna Kant and another visiting Expert Mr. Jan Peters.

2. Review of project work. Detailed assessment of technical problems and recommendations for problem solving.

In view of the substantial programme of work to compile the three lectures which required full time activity until 10.00 p.m. on Friday 27th March 1987, Dr. Krishna Kant requested the author to extend the mission by a further week and appropriate action was taken by UNDP, extending the departure date from 1st April to 8th April, 1987.

The main effort expended towards the lecture programme tended to polarise this particular mission and it was not possible to visit appropriate industries to formulate detailed recommendations for future action. However, several projects currently being worked on in MAEP, New Delhi were reviewed and the progress to date is summarised in Section 5 "Technological Participation".

In order to maximise the input from the author during the second mission planned for May/June, the Chief Project Co-ordinator arranged interviews with senior management of plants in Bangalore and Ranchi as part of a briefing, prior to making visits during the next mission. These are listed in Appendix I.

On Friday 13th the author attended an important meeting chaired by the Additional Secretary Dr. N. Seshagiri to review forthcoming project activities. Those present were:

1. Dr. N. Seshagiri
   Additional Secretary for Govt. of India
   Department of electronics

2. Dr. B.K. Gairola
   Additional Director
   CAD Group

3. Mr. M.S. Vasudeva
   Additional Director
   HVDC

4. Mr. G.S. Varadan
   Additional Director
   A.A.P.P.

5. Dr. Krishna Kant
   Additional Director
   M.A.E.P.

6. Dr. Mahesh Chandra
   Flexible Manufacturing

The following main points were discussed:-

1. The importance of linkages between networking computers in process control industries, with automation in manufacturing and the role of the Microprocessor Application Engineering Programme in co-ordinating these.

2. The need for locally developed operational and application system sofware to meet the unique requirements of Indian working practices.

3. Pilot manufacturing and process plants for development of software systems and tackling problems of the man/computer interface in labour intensive operations.

4. The itinerary of the author to include visits and discussions with all major project sectors including railways, power distribution, machine tools, process industries and sensor/ instrument developments. Dr. Krishna Kant was requested to draw up a collective programme with his colleagues, to maximise UNIDO Expert input during the second visit by the author, planned for May/June 1987.

4. LECTURE PROGRAMME

Referring to Appendix II "Summary of Lectures" - the objective of the lecture series was to bring out the concept of Systems Engineering and latest technological advancement in the fields of instrumentation, process control and factory automation.

Specific lectures prepared by the author during the mission comprised:

- Sensor Technology, present and future, 50 pages 44 illustrations.

- Process Control Instrumentation, 56 pages 26 illustrations.

- Computer Aided Manufacturing, 12 pages 6 illustrations.

Additional lectures delivered by Mr. J. Peters and Dr. Krishna Kant were on the subjects of:

- Microcontrollers

- System Engineering Concepts

- Automation Techniques

The latter two are the subject of a separate report by Mr. J. Peters.

A concluding lecture describing the role of M.A.E.P. was presented by Dr. Krishna Kant.

Representatives totalling 60 in number were invited from Road Research, Avionics, Water Treatment, NPC, ISI and other major industries including public sectors like BHEL, IPLC, EIL etcetera.

5. TECHNOLOGICAL PARTICIPATION

The following projects were reviewed:-

1. Flash butt welding monitoring system for railways.

2. Microprocesor based road user cost study.

3. Electronic track survey system for railways.

4. Steel Blooming Mill Computer Monitoring and Control System.

Activities during this mission were confined to introductory discussions and arrangements for follow up actions during May/June 1987. Of the projects listed above, the Blooming Mill was by far the most ambitious, involving control of the process as well as monitoring of data relating to it. It was tentatively agreed that the author would visit Ranchi for a period of one week during May to assist in this area.

In addition, preparatory discussions were held with the General Manager, H.M.T. (Bangalore) on the subject of advanced cnc systems for machine tools. It was subsequently planned for the author to visit Bangalore for a period of three weeks during May/ June.

6. FUTURE MEASURES FOR PROMOTING MICROPROCESSOR APPLICATIONS

A major role expected of MAEP was to provide assistance in improving the efficiency and quality of existing process plants, many of which had been running for twenty years and more. It was thought that by applying more modern control system engineering techniques the productivity could be improved. When it is realised that only 1% improvement may mean large sums of revenue when applied to a process delivering tens of thousands of gallons or hundreds of tons in weight, the added value from a relatively small investment in instrumentation quickly recovers the outlay. These recommendations reflect the responses from delegates attending the lectures presented on 2nd and 3rd April summarised in Appendix II.

At present the capability exists in MAEP for operating small project teams with in depth knowledge of current state of the art microprocessors and associated application software for specific projects. There is also experience in interfacing microprocessors with various transducer inputs. What is now required is a step forward to take complete systems, analyse the process, highlight areas for improvement, select the appropriate equipment and implement the recommendations. This is referred to as a "System Engineering" phase in Control Engineering and such projects may typically take two years from inception to realisation of a working system. Activities include system analysis, specifications, selection of equipment hardware, writing special software, installing equipment and proving software. During this period a project team would learn the detailed characteristics of the process and the best performance it would be possible to achieve a) by computer modelling b) by actual tests.

Such programmes proposed above require a firm commitment in terms of resources, people and hardware, but there do not appear to be any short cuts to acquiring the necessary capability in this field, which typically may require a minimum time scale of two years as stated above.

It is recommended that consideration be given to starting a number of major system engineering projects which will provide the motivation and disciplines for problem solving and training, in addition to starting with specialist training courses which may or may not be totally productive in terms of project engineering skills necessary for tackling fresh system problems as they arise in the future. It is estimated that such major system engineering projects would require 50% input from a UNIDO expert team leader for the duration of each project.

APPENDIX I

ITINERARY FOR E.J. WIGHTMAN

Date			Activity
5th March	-	3.00 A.M.	Arrive at Lodhi Hotel
5th March	-	3.00 P.M.	Visit UNDP for briefing from Dr. M. Kamal Hussein Senior Industrial Development Field Adviser and Mr. M. Ramachandran, Senior Programme Officer.
6th March	-	9.00 A.M.	Visit Dr. Krishna Kant, Chief Project Co-ordinator (Tel. 362811) to review terms of reference for Job Description 84/030/11-02/?1.9.E
13th March	-	11.00 A.M.	Meeting with Dr. N. Seshagiri, Addl. Secretary future policy & objectives for MAEP.
18th March	-	10.30 A.M.	Meeting with Dr. N.R. Mantena - General Manager H.M.T. Limited CNC Systems Division, Bangalore concerning potential development of CNC systems
23rd March	-	3.00 P.M.	Meeting with Dr. Bhattacharya Project Co-ordinator, MAEP (SAIL, Ranchi). Reference Blooming Mill project.
30th March	-	2.00 P.M.	Meeting with Mr. Nirbahar Neogi, Astt. Research Manager Power & Electronics Group, Steel Authority of India Limited - Ranchi to discuss details of steel blooming mill project
31st March	-	10.30 A.M.	Meeting with Mr. Aswath Narayan, Chief engineer, Northern Railways concerning automation of butt welding process.
2nd April(			
(	-	Lecture Programme - Appendix II	
3rd April(			
6th April	-	9.00 A.M.	Meeting at UNDP with Dr M.K.Hussein & Mr. Varadan - Additional Director A.A.P.P. to discuss future projects
6th April	-	3.30 P.M.	Meeting with Dr. Gairola, Additional Director CAD Group & Dr. Cameron to discuss FMS, CAM, CAD.
7th April	-	10.30 P.M.	Depart for U.K.

APPENDIX II

SUMMARY OF LECTURES

INDUSTRY MEET ON MICROPROCESSOR APPLICATIONS

(2nd and 3rd April, 1987)

PROGRAMME SCHEDULE

ORGANISED BY:

Microprocessor Application Engineering Programme

Department of Electronics (CCI Wing)

New Delhi

Date: 2 April, 1987

9.00 A.M. - 9.30 A.M.	- Registration
9.30 A.M. - 10.00 A.M.	- Inauguration
10.00 A.M. - 10.45 A.M.	- L1: Introduction and System Engineering Concepts (I)
10.45 A.M. - 11.30 A.M.	- L2: System engineering Concepts (II)
11.30 A.M. - 11.45 A.M.	- Tea
11.45 A.M. - 12.30 A.M.	- L3: Sensor Technology present and future (I)
12.30 A.M. - 1.15 P.M.	- L4: Sensor Technology present and future (II)
1.15 P.M. - 2.00 P.M.	- Lunch
2.00 P.M. - 2.45 P.M.	- L5: Process Control Instrumenation (I)
2.45 P.M. - 3.30 P.M.	- L6: Micro Controllers
3.30 P.M. - 3.45 P.M.	- Tea
3.45 P.M. - 4.30 P.M.	- L7: Process Control Instrumentation (II)
4.30 P.M. - 5.00 P.M.	- Technology Review / Discussions

Date: 3 April, 1987

9.30 A.M. - 10.15 A.M.	- L8: Automation Techniques (I)
10.15 A.M. - 11.00 A.M.	- L9: Automation Techniques (II)
11.00 A.M. - 11.15 A.M.	- Tea
11.15 A.M. - 12.00 P.M.	- L10: Automation techniques (III)
12.00 P.M. - 1.00 P.M.	- L11: Computer Aided Manufacturing - (General)
1.00 P.M. - 1.45 P.M.	- L12: Computer Aided Manufacturing - (Implementation)
1.45 P.M. - 3.00 P.M.	- Lunch
3.00 P.M. - 4.00 P.M.	- L13: Role of M.A.E.P.
4.00 P.M. - 4.15 P.M.	- Tea
4.15 P.M. - 5.00 P.M.	- Discussions on future strategy.

LIST OF PARTICIPANTS FOR INDUSTRY MEET ON MICROPROCESSOR & APPLICATIONS (2-3 April, 1987)

MARUTI UDYOG LIMITED

1. Mr. G.S. Maheshwarl
2. Mr. A.K. Gupta

STEEL AUTHORITY OF INDIA LIMITED

3. Dr. S.C. Mehta
4.
5.

WATER AND POWER CONSULTANCY SERVICES (INDIA) LTD.

6. Mr. L.N. Gupta
7. Mr. T. Datta Majumdar

ELECTRONICS TEST AND DEVELOPMENT CENTRE

8. Mr. S.S. Phoola
9. Mr. Arun Dhingra

DEFENCE

10. CDR H.S. Sharma

INDIAN RAILWAY (NORTHERN RAILWAY)

11. Mr. Satya Pal
12. Mr. V.K. Duggal
13. A.K. Bhattacharya

14a L.C. Monga

14b Y.V. Aswathayanarayam

CENTRAL ELECRICITY AUTHORITY

15. Mr. K. Ramanthan
16. Mr. D.P. Sinha
17. Dr. S. Mukhopadhyay

BHARAT ELECTRONICS LTD.

18. Mr. S.S. Chowdhary
19. Mr. S.C. Rustgi
20. Mr. Sethuraman

CENTRAL ELECRONICS LIMITED

21. Mr. R.C. Gupta
22. Mr. B. Roy
23. Mr. D.K. Jain

INDIAN RAILWAYS (WESTERN RAILWAY)

24. Mr. Arvind Raje
25. Mr. M.S. Ekbote

BHARAT HEAVY ELECTRICALS LIMITED

26. Mr. P.N. Avasthy
27. Mr. N. Ramachandra
27a Mr. D. Krishnamurthy

ELECTRONIC CORPORATION OF INDIA LIMITED (HYD)

28. Mr. R.V. Prabhakara Rao
29. Mr. R. Vinkata Raman
30. Mr. S. Ramachandran

STEEL AUTHORITY OF INDIA LIMITED

31. Mr. N. Niyogi

CENTRAL SCIENTIFIC INSTRUMENTS ORGANISATION

32. D.P. Goel

INDIAN STANDARD INSTITUTION

33. Mr. B.K. Mahata
34. Mr. Pavan Kumar
35. Mr. W.D. Sachdeva

TAYLOR INSTRUMENT COMPANY (INDIA) LIMITED

36. Mr. J.K. Dhar

MUNICIPAL CORPORATION OF DELHI

37. Mr. S.R. Kapur
38. Mr. S.M. Khanna
39.
40.
41.

DEPARTMENT OF TELECOMMUNICATIONS (TELECOM RESEARCH CENTRE)

42. Mr. Vinay Topa
43. Mr. P. Sayinath
44. Mr. J.M. Joshi
45. Mr. P.C.S. Negi

HARYANA STATE ELECTRONICS DEVELOPMENT CORPORATION LIMITED

46. Mr. A. Kumar
47. Mr. Mohan Dudeja
48. Mr. P.K. Goel
49. Mr. N. Ranjit

APPROPRIATE AUTOMATION PROMOTION PROGRAMME

50. Mr. G.S. Varadan
51. Mr. M.R. Rajagopalan
52. Mrs. Hema Mallnl

CAD

53. Dr. Ahmed Cameron
54.

HVDC

55. Mr. M.S. Vasudeva
56. Mr. B.S. Bedl

NTPC

57. Mr. R.K. Kaul
58. Mr. Vinod Viswanl
59. B.S. Rao

N.E. RAILWAYS

60. Mr. M.P. Joshi

RCPO

61. Wg. Cdr. S.P. Shukla

62. Wg. Cdr. P.R. Modi

RAILWAY BOARD

63. Mr. A. Singh Dt.Dr. (Civil Engineering)

CONTENTS

SENSOR TECHNOLOGY-PRESENT AND FUTURE

SUMMARY

This paper reviews the current state of the art in sensor technology in terms of fundamentals in measurement of the most widely used forms of process variables and discusses how the impact of microprocessors in recent years has precipitated the development of new forms of transducers.

Two areas of development, namely piezo-electric and fibre-optics are reviewed, together with the benefits of "smart" sensors which incorporate microprocessors for local linearising, alarms, control set-points and communication protocols.

It is concluded that while the microprocessor is seen to be an important tool for the control system engineer, the fundamental role of the sensor in determining the quality and productivity of a process is still predominant. The future of the development of advanced forms of "smart" sensors is seen to be a growth area.

PROCESS CONTROL INSTRUMENTATION

SUMMARY

This paper reviews the techniques currently available for measuring and transmitting data from process control applications, with particular reference to the advances made in recent years by the introduction of microprocessors in all stages of the process, from fundamental measurements, communications, supervision and control.

The two most significant areas of applications of microprocessors are seen to be in the development of intelligent interfaces or terminals at plant level and/or "smart" sensors, together with networking of such terminals to create a satellite distributed concept of hierarchial control.

It is concluded that if the present trend continues, the further development of "smart" sensors to enable process functions to be locally managed, is predictable.

COMPUTER AIDED MANUFACTURING

SUMMARY

This paper sets out to analyse the elements comprising "Computer Aided Manufacture". The subject embraces computer aided design, process planning, nc machine tools, flexible machining systems, automatic inspection, the role of sales invoicing, accounts, and a central database used for linking these functions together.

The importance of the human operator is discussed and arguments are put forward which hope to demonstrate how output and quality can be improved without displacing employees.

In order to assist communicating the benefits which CAM has to offer, it is proposed to set up a pilot cell to show how either an individual process,or a totally integrated production unit may benefit from the use of microprocessors, with software tailored to suit the working pratices and customs of the Indian people.

Reference is made to the process industries where similar problems exist in networking various specialist functions together, using the same computer hardware.