

Conference News

ECE INTERNATIONAL SEMINAR ON INDUSTRIAL ROBOTICS

The Seminar on Industrial Robotics '86 – International Experience, Developments and Applications was held at Brno (Czechoslovakia) from 24 to 28 February, 1986, at the invitation of the Government of Czechoslovakia and under the auspices of the Working Party on Engineering Industries and Automation of the United Nations Economic Commission for Europe.

The proceedings of the Seminar were opened by Mr. J.A. Kennerley, Deputy Director of the ECE Industry and Technology Division, on behalf of Mr. K.A. Shalgren, Executive Secretary of the Economic Commission for Europe.

Briefly touching upon the subject of the Seminar, Mr. Kennerley drew attention to the growth in the world-wide programmable robot population, which between 1981 and 1985 had increased from 30,000 to more than 100,000, and to the fact that experts in certain countries forecast a significant growth in that area. He was confident that, in the course of its deliberations, the Seminar would draw conclusions and make valuable recommendations both for the consideration of Governments and experts and for the future activities of the ECE Working Party on Engineering Industries and Automation. The presence of nearly 200 participants from 28 countries and 11 international organizations attested to the importance and world-wide interest of that Seminar topic.

1. Sections

Sixty papers as shown in Table I, were presented during 5 sessions.

2. Round-table discussion

On Wednesday, 26 February, a round-table discussion was held on the following three themes:

- Recent trends in the design of industrial robots,
- The role of industrial robots in automated factories, and
- Human factors in the process of robotization.

The first topic, dealing with recent trends in robotics, was introduced by Mr. Knight and Mr. Morecki. Several other speakers also took the floor in order to illustrate new developments in robot mechanics and kinematics, sensing devices, control systems and machine intelligence, software means, etc. It was agreed that the robot should be designed in the optimum way to fulfil primarily the given industrial task. Since installation costs increased with higher accuracy, reliability, speed, repeatability, control sophistication, etc., some compromise between costs and available functions should always be sought.

Participants in the round-table underlined the necessity of incorporating recent robots characterized as “computers with arms, legs and sensors” in manufacturing cells, centres and systems in order to make them an integral part of the manufacturing network system. In this respect, new features such as robot mobility, flexible links, self-diagnostics and the use of three-dimensional sensors were also discussed.

While the engineering industries had themselves remained the dominant robot users, many new application areas had proved to be ideal for robotization: the textile, shoe, food and glass industries, building and construction, space and underwater applications, medical applications, etc.

The second topic concerning automated, unmanned fac-

tories, was introduced by Mr. Samorodskikh and Mr. Sugimoto. During the discussion, it was stressed that it was not the current robots which were hampering the increased orientation towards factor automation; the design of machine tools and other factory equipment should be adapted for “marriage” with robots in computer integrated manufacturing systems. There was a shift towards the automation of medium and small batch production, which required frequent resetting associated with demands for higher flexibility, such as better sensing and positioning capabilities, real-time feedbacks, rapid reprogramming, quick tool-change, on-line scheduling of operations, co-ordination with the overall control system, etc. In this connection, several topics had been proposed for future ECE seminars.

The third topic, pertaining to human factors, was introduced by Mrs. Mårtensson and Mr. Ebel. Special attention was given to the interrelated problems of safety and work organization. An example of a robotized welding work-station designed in order to minimize the risk of accidents was presented by Mr. Nicolaisen (Federal Republic of Germany).

Another recurring theme was the human reaction to a high-technology environment. New approaches towards the training and retraining in particular of operators, programmers and management were considered in the light of the changing structure of employment.

The discussion was summarized by Mr. Čop, Chairman of the Seminar, who welcomed the opportunity provided by the round-table to enrich the programme of the Seminar, thanks to the high level of competence of the specialists participating, the great interest on the part of the audience and the many topical questions forwarded to the members of the discussion panel. He emphasized that the major results of the round-table discussion should be properly reflected in the conclusions and recommendations of the Seminar.

3. Conclusions

a. In view of the technological advances in robotics, the rapid diffusion of robots and their growing importance in enhancing product quality and productivity, in satisfying the needs of the consumers and in improving working conditions, the participants considered that the Seminar had been timely and useful. They recognized the need for international co-operation and exchange of views and experiences in this highly dynamic area, and suggested that the Economic Commission for Europe was well placed to play an important role in that respect and that there should be further ECE activities and seminars devoted to selected aspects of automated production.

b. Robots and robotic systems constituted merely one component – albeit an important one – of more complex types of integrated manufacturing systems, such as flexible manufacturing systems (FMS), as well as the computer integrated manufacturing (CIM) systems of the near future. Accordingly, it was felt that robots should be perceived in the context of complete and integrated production systems. Speakers stressed the importance of designing robots which could easily communicate with other types of computer-controlled equipment. They underlined the need for R and D on hardware interfaces and for the elaboration of common data communication protocols, standard programming languages for robots and other types of equipment in FMS and CIM.

Table I List of papers presented at the UN/ECE seminar on Industrial Robotics '86

Title of paper	Author(s)	Country and/or organization	Original language
Present State and Prospects in Industrial Robotics in Czechoslovakia	Mr. V. Čop	Czechoslovakia	E†
Robots in Flexible Assembly	Mr. C. Johansson and Mr. N. Mårtensson	Sweden	E
Interaction between Man and Robots	Mrs. L. Mårtensson	Sweden and International Federation of Automatic Control (IFAC)	E
Some Aspects of the Association of the CNC-Lathes and Polygamous Robots	Mr. P. Semetkay and Mr. F. Patuzzi	Hungary	E
Mechanical and Control Aspects of Heavy-Duty Robots	Mr. O. Banhegyi and Mr. L. Zari	Hungary	E
Systemology in the Design of Robots and Flexible Manufacturing Systems	Mr. J. Buda	Czechoslovakia	E
Trends in the Development of Sensor Systems and their Use in Some Technological Areas	Mr. I. Plander	Czechoslovakia	E
The Concept of the Development of Industrial Robots in Czechoslovakia	Mr. J. Buza, Mr. I. Marcin and Mr. Strojny	Czechoslovakia	R
Approaches to the Evaluation of the Economic Benefits of Using Industrial Robots and Manipulators	Mr. A. Chudik	Czechoslovakia	E
Robotization and the Human Factor	Mr. Z. Kozar and Mr. A. Fiser	Czechoslovakia	E
Education and Training of Automation and Robotization Specialists in Czechoslovakia	Mr. B. Chvala	Czechoslovakia	E
Forms of Government Support for the Development of Robotization in Czechoslovakia	Mr. J. Benes	Czechoslovakia	R
Experience of the Introduction of Industrial Robots and Manipulators in Czechoslovakia	Mr. J. Zan and Mr. J. Buban	Czechoslovakia	R
Robotized Lamp Assembly Station for Bus Manufacturing	Mr. J. Marton, Mr. I. Lepsenyl and Mr. P. Jakubik	Hungary	E
IRB-60 Z Welding Robot	Mrs. E. Paszewin, Mr. M. Petz, Mr. Z. Wawerek and Mr. E. Smoderek	Poland	R
PR-02/SP System of Controlling a Group of Industrial Robots	Mr. T. Wanski	Poland	R
New Control System for IRB-6 and IRB-60 Robots	Mr. P. Jablonski, Mr. M. Pachuta and Mr. T. Wanski	Poland	R
Industrial Application of RIMP-Series Industrial Robots	Mr. E. Buc and Mr. Z. Strojewski	Poland	R
New Social Options by the Use of Robots within an Appropriate Work Organization	Mr. F. Margulies	Austria and International Federation of Automatic Control (IFAC)	E
Some Problems involved in the Design of Arc-Welding Robot Stations	Mr. L. Bozenko	Poland	E
Robotization Development Programme in Poland in 1986–1990	Mr. J. Lapa and Mr. S. Golomo	Poland	R
The Impact of Industrial Robots on the World of Work	Mr. K.-H. Ebel	International Labour Office (ILO)	E
A Consultancy Service in Industrial Robotics: Methods and Experience	Mr. G. Krainz	Austria	E
Robotics Developments and Industrial Applications	Mr. P. Cigna, Mr. G. Marinoni, Mr. G. Capello and Mr. M. Actis Dato	Italy	E
The Role of Training Centres in the Introduction of Industrial Robots in Heavy Engineering Industries	Mr. W. Händel	German Democratic Republic	E
Automation of Technological and Transport Processes in the ZTS Martin – Heavy Engineering Works	Mr. J. Nemcsics	Czechoslovakia	E
The IRB Adaptive Industrial Robot	Mr. Z. Rudnicki	Poland	E
Short-term Flexibility of Industrial Robots in Small-Series Production in Transport Engineering Enterprises in the GDR	Mr. G. Dutt	German Democratic Republic	R
Use of Industrial Robots in Denmark – Examples of Application	Mr. J. Nielsen	Denmark	E
A Major Robot and Automation Initiative for Australian Manufacturing	Mr. C.D. Cook		E‡
Social and Cultural Impact of Robotics	Mr. G. Quaranta	Italy	E

Title of paper	Author(s)	Country and/or organization	Original language
National Policies and Patterns of Robot Diffusion: United Kingdom, Japan, Sweden and the United States	Mr. J. Fleck and Mr. B. White	United Kingdom	E
Studies and Research on Flexible Devices of Average capacity	Mr. R. Olteanu, Mr. C. Somesan, Mr. C. Comsa, Mr. V. Catana and Mr. M. Brehar	Romania	E‡
Increasing Versatility of Gripping Appliances and Reliability of Efficient Manipulators	Mr. R. Olteanu, Mr. C. Somesan, Mr. C. Comsa, Mr. V. Catana and Mr. M. Brehar	Romania	E‡
Synchronous Control of Robots and Manipulators in Manufacturing cells	Mr. M. Etterer	Austria	E
The Diffusion of Industrial Robots in OECD Countries and the Impact Thereof	Mr. C. Edquist and Mr. S. Jacobsson	Sweden	E
Safety Problems Related to Robots	Mr. P. Nicolaisen	Federal Republic of Germany	E
Industrial Robot Standardization at ISO	Mr. J. Chabrol	International Organization for Standardization (ISO)	E
Industrial Robots for Flexible Manufacturing Systems	Mr. V.A. Serdukov	USSR	R
Flexible Manufacturing Modules for Assembly of Instruments	Mr. A. Ulyanov	USSR	R
Robotics in France	Mr. J. Chabrol	France	E
Ultrasonic Distance Measuring and Imaging Systems for Industrial Robots	Mr. J. Knight, Mr. S. Pomeroy, Mr. H. Dixon and Mr. M. Wybrow	United Kingdom	E
Design of Flexible Devices for Forging Lines	Mr. R. Olteanu, Mr. C. Somesan, Mr. C. Comsa, Mr. V. Catana and Mr. M. Brehar	Romania	E‡
Software Tools for Automated Manufacturing Cells	Mr. M. Duncan and Mr. D. Williams	United Kingdom	E
Present State and Trends in Robot Technology	Mr. K. Sugimoto	Japan	E
Selected Problems Concerning Structure of Drives, Accuracy and Fibre Optic Sensors in Anthropomorphic Manipulators	Mr. A. Morecki	Poland and International Federation for the Theory of Machines and Mechanisms (IFTOMM)	E
Flexible Automation of Spot Welding in the Automotive Industry	Mr. A. Borisenko and Mr. E. Gleizer	USSR	R
[not presented]			
Robotized Assembly Complexes for Series Production in Engineering Industries	Mr. B. Samorodskih	USSR	R
[not presented]			
Automated Material Handling and Transfer Using Industrial Robots	Mr. P. Ulrich	German Democratic Republic	E
Utilization of Modern Production Automation: Some Technological, Economic and Social Impacts	Mr. J. Temmes, Mr. J. Ranta, Mr. K. Koskinen and Mr. R. Hyotylinen	Finland	E
Group Servicing of Metal-Cutting Machine Tools by Industrial Robots – Experience Gained in the Use of IR to Produce Components of the Solid-of-Revolution Type	Mr. I. Dvoskin	USSR	R
Multilateral Co-operation Among CMEA Member States in Industrial Robotics		Council for Mutual Economic Assistance (CMEA)	R§
Development Trends of Robotized Complexes	Mr. T. Nenchev and Mr. N. Dragoichev	Bulgaria	R
Problems of Work Organization in Robotized Complexes	Mrs. S. Grozdanova	Bulgaria	R

* The papers are published in the original language only and the summaries are published in the three working languages of ECE, unless otherwise specified.

† Also available in French and Russian.

‡ Summary only issued.

§ Also available in English.

c. During the Seminar, particular attention was paid to the need for the development of various types of sensors for robots and, in particular, of sophisticated robots equipped with intelligent sensors in order to allow the robots to adapt better to their human, physical and working environment. Participants agreed that sensors would play a vital role in the application of new generations of "intelligent" robots, which would be required in future far-reaching self-contained production systems, e.g. for the automation of assembly operations. Several papers which had been presented illustrated the important advances which had been made and which were currently on the verge of being adopted in industrial applications. During the coming decade, the use of sensor-equipped robots was expected to see rapid growth, owing to improvements in sensors and sensor systems as well as to continuously declining computing costs.

d. During discussion on future robot designs, many speakers considered that there was a strong possibility of mobile multi-purpose robots being applied in the near future. Robots with additional degrees of freedom would require even faster and more accurate sensor systems. The development of mobile robots equipped with advanced sensor systems, multi-task grippers, etc., would, however, pose complicated technical research problems while also raising a number of social and human questions which would have to be examined. There was, for instance, the question of how workers with little or no experience in the use of robots would react to situations where robots moved around them in a factory, undertaking multiple tasks, and these not always in a predetermined way. Very little was currently known about the psychological and sociological problems which could arise under such conditions. There was an urgent need for research aimed at identifying and solving those problems before robots of that kind were introduced in industry, in order to avoid worker resistance.

e. In the development of robots, as in that of other types of computer-based systems, the elaboration of software represented a bottleneck which had repercussions not only on their technical development but also on their diffusion in industry. Since robots were increasingly being integrated into more complex manufacturing systems, as well as design and planning systems (CAD, CAM, etc.), they must be able to be linked with a wide range of other computer-based equipment. In the process of systems integration, software and communication features represented major obstacles. If each component in a system were designed with standardized controls and communication interfaces, and if they could use standardized programs, considerable saving could be achieved of both money and efforts in the implementation of integrated systems.

f. Participants underlined the growing importance of group technology (GT) approaches, which were needed for the simplification of product design in automated manufacturing.

g. The Seminar agreed on the desirability of developing new economic indicators and methods for evaluating investment in robots and other new computer-controlled production technology. Conventional methods focused mainly on labour saving and did not evaluate the indirect benefits, such as improved product quality and better working conditions. Nor did they consider investment in robots in the context of longer-term and more far-reaching automation programmes, leading to substantial saving through synergistic effects and the more efficient use of all production factors (labour, machines, building, capital tied up in processes and inventories and material). It was felt that different application areas and manufacturing processes called for the use of different economic indicators and evaluation methods.

h. Most participants were of the opinion that the effects of robotics on aggregate employment were extremely difficult to measure since they were determined by a large number of complex factors about which little was known. Examples could be found illustrating both negative and positive effects of robotics on employment. As to the effects on the employment structure, it was unanimously agreed that there would be

significant displacement of labour, which should be compensated by redeployment and retraining programmes as mentioned above.

i. Far more attention should be paid to the social and human factors in the development and use of robots. This would call for a careful assessment of the new role of workers, including the nature, extent and mode of their communication with fellow workers, supervisors and managers, in order to avoid the adverse psychological effects of stress, isolation, etc. One way of overcoming these problems could be to involve all categories of personnel from the user firm – engineers, as well as future operators and maintenance staff – in the design of automated production systems at an early stage.

j. It was agreed that, in the light of the rapid increase in robot applications, more attention should be given to the safety of people working in areas where robots were being used. The question of safety should be taken into account in the future development of new robot concepts, such as mobile robots. In that context, accident and error analysis and simulation approach were mentioned.

k. Participants noted that Governments played an important role, not only in promoting research and development on robots but also in encouraging their diffusion, in particular during the early phases of the so-called learning curve of robotization. In that context, awareness schemes, advisory services and direct investment grants or programmes were discussed.

l. Participants concluded that robotics was an area particularly indicated for international co-operation. It addressed a number of important issues of a technical, economic and social nature, it was a field in which considerable scope existed for co-operation in the development of standards, and it frequently involved licensing, joint ventures, buy-back and trade agreements.

4. Recommendations

On the basis of the conclusions indicated above, the Seminar agreed on the follow recommendations:

(i) ECE should continue to undertake studies and/or organize seminars, symposia and study tours on well-defined topics related to robotics and computer-aided manufacturing, in order to assess trends and permit increased exchange of information. Possible topics for such activities could include:

- Design and implementation of systems from the viewpoint of social and psychological considerations, including aspects related to working conditions, work content, rewards, training and career possibilities, safety, etc.;
- New methods for appraising economic and social benefits;
- Standardization of control systems, communication interfaces and programming tools;
- The design, implementation and evaluation of educational training and retraining schemes; and
- Research and development in non-engineering applications.

(ii) Efforts aimed at standardization undertaken by ECE and other governmental and international non-governmental organizations should be directed towards achieving international consensus on effective guidelines for decision-making relevant to assuring compatibility of interfaces in elements of computer-aided manufacturing systems, including robots.

(iii) ECE and other international organizations should encourage and undertake activities aimed at strengthening international co-operation and the exchange of information on computer-aided manufacturing systems, including robots.

(iv) The papers and the Report of the Present Seminar should be derestricted and the Czechoslovak authorities in consultation with the ECE secretariat should, if possible, arrange for the publication of a comprehensive report on the Seminar.

Abridged Report prepared by
P. Esrom
(c/o Editor)