Robotica (1985) volume 3, pp 203–204

Introduction to the special FMS issue

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(Received: May 7, 1985)

It is pleasant to realise that every leading institution and manufacturing company in the world is dealing with some aspects of flexible automation, because many researchers and managers in industry have found that the concept of designing and making goods and products on order, rather than for stock, is the key issue in order to cut down manufacturing costs and lead time, and eventually to stay in business in the future.

The important fact to realise is that demand, as well as the available technology, are changing at an exponentially growing rate, but money is tight and worldwide competition is tough; thus companies need to react to changes much faster and in a more flexible way than in the past, not only when designing new products, but also when manufacturing them.

But how can one design manufacturing systems for a variety of different products of batch sizes ranging from one to several hundred, or more? How can managers see all different but important aspects of a complex business? What is required to be able to make correct decisions when things move as fast as they move today? How can one optimise information flow, manufacturing and all related processes at the same time? How can one increase design and/or manufacturing productivity by 2 to 10 times and decrease production costs at the same time by 10 to 50 percent?

The answer is not simple, but it is quite obvious that CIM (Computer Integrated Manufacturing) and FMS (Flexible Manufacturing Systems) are offering an alternative solution compared to conventional manufacturing systems (e.g. the manually controlled or partly-assisted job shop, the flow line systems, the transfer lines, etc.) because they utilise reprogrammable equipment (e.g. CNC machine tools; assembly, welding, etc. robots; coordinate measuring machines, etc.), capable of adapting to changes and working very efficiently (i.e. close to 100% utilization) because of the overall computer-based organization.

This issue of *ROBOTICA* concentrates on FMS, which is a very important part of the "total concept", integrating the business data processing system, CAD, CAM and FMS by means of distributed processing systems, databases, computer networks and a variety of software modules, incorporating expert systems.

The first paper entitled "FMS in CIM" introduces the most important building blocks mentioned above and underlines the importance of compatible interfaces, hardware and software tools designed to integrate them, as well as it explains a dynamic operation control concept for FMS, based on the "variable route" FMS part programming method and an expert system.

The guest contributors list is opened with an industrial case study paper "Overall control within a Flexible Manufacturing System", outlining the differential control architecture aspects "within" and "above" FMS, as well as giving an industrial example of Cincinatti's FMS system.

Tooling and tool management represent one of the key issues when designing and operating flexible machining systems. The solution described in the next industrial paper "The application of a flexible tooling system in FMS" is not only appropriate from the dynamic FMS operation control point of view, but also economic standpoint.

The vast amount of work put into planning and operation control of FMS systems by different research institutions and industry is represented by the next four papers, "Planning of Flexible Manufacturing Systems", "Production scheduling and operation control of Flexible Manufacturing Systems", "Grouping problem in scheduling FMS", "An application of simulation theory in FMS". It is important to realise that there are different approaches being developed as well as tested in this area, and including what it has been said about dynamic control of FMS in the first paper ("FMS in CIM"), they are often contradictory. Nevertheless, they represent different views of the same problem, emphasizing the need for dynamic scheduling software, alternative routing of randomly (or almost randomly) loaded parts and expert systems when running FMS.

The next two papers ("VAL-II, A Language for hierarchical control of a robot based automated factory" and "Software tools for FMS and FAS (Flexible Assembly Systems) preliminary design: an industrial case study") underline that FMS is not only for machining, but it is a "know-how" applicable in a variety of different industries, including robotised assembly. The strength of the second paper in this group is that it not only gives some theoretical considerations regarding dynamic operation control and FMS/FAS simulation, but also gives an industrial case study.

The last paper is a very forward looking one, because it not only gives a survey of some important work carried out in Artificial Intelligence and expert system development, but also outlines the need for such systems to be put in operation in industry, and in particular in FMS, in

order to increase the local as well as system level intelligence of these complex systems.

Finally, let me express my thanks to Professor Rose, the editor of this journal for inviting me to become the guest editor of this special FMS issue and to all contributors for their interesting and valuable papers, showing a large variety of different concepts and exciting research work carried out in this field.

https://doi.org/10.1017/S0263574700002289 Published online by Cambridge University Press