

Digital factories, production networks

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Today's complex manufacturing systems operate in a changing environment rife with uncertainty. The performance of manufacturing companies ultimately hinges on their ability to rapidly adapt their production to current internal and external circumstances. The Hungarian national R&D project led the Computer and Automation Research Institute (SZTAKI), Hungarian Academy of Sciences, combines the concepts of intelligent manufacturing systems and digital enterprises in addressing the above problems.

Manufacturing systems of our epoch work in a fast changing environment full of uncertainties. Besides internal factors (e.g. malfunctions, break downs), the main external reasons of uncertainties are:

- fast increasing and diversified customer demands,
- increasing role of the one-of-a-kind production, fast sequences of new tasks,
- increase in the number and the speed of communication channels,
- appearance of new technologies,
- fast changes in the partners (suppliers, distributors, customers, purchasers),
- instability of market circumstances (e. g. the hectic changes of raw material prices).

Increasing complexity is another characteristics which shows up in production processes and systems and in enterprise structures as well.

The concept of the *digital enterprise*, i.e. the mapping of all the important elements of the enterprise processes by means of information technology tools gives a unique way of managing the above problems. However, the management, the optimal or near to optimal exploitation of the available huge amount of information cannot be imagined without the effective application of the methods and tools of *artificial intelligence*. By this way, systems can be developed that are expected to solve, within certain limits, unprecedented, unforeseen problems on the basis of even incomplete and imprecise information (the early concept of *Intelligent Manufacturing Systems (IMS)* by late J. Hatvany, from 1983).

The partners in the project on Digital Enterprises, Production Networks supported by the National Research and Development Programme (NRDP) in Hungary, build a well-balanced “academia-industry” cluster: GE Hungary Rt., as a big manufacturing enterprise, MT-System Ltd. as an information technology SME are on the industrial side, while the academia is represented by the Budapest University of Technology and Economics, Miskolc University, and SZTAKI.

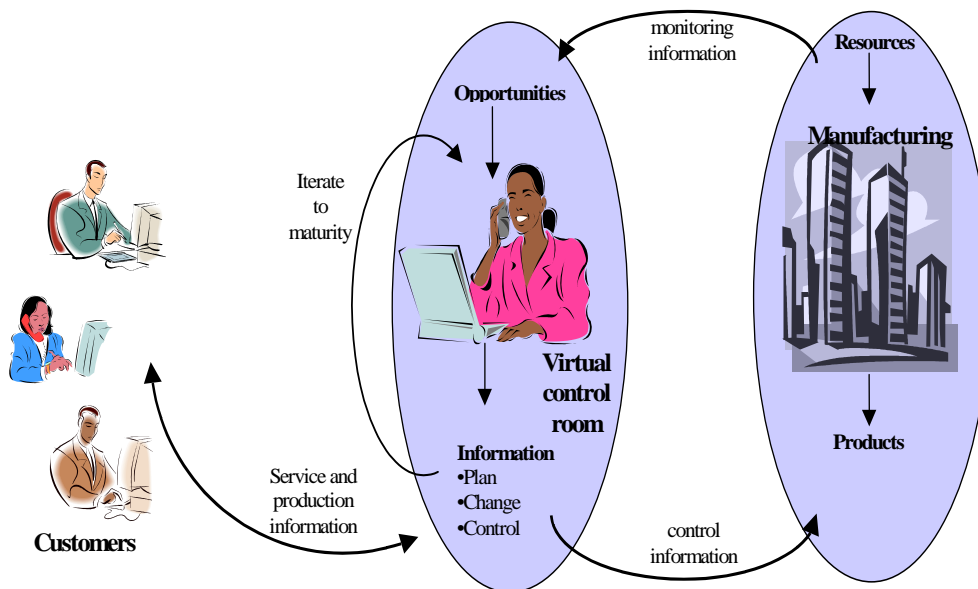


Figure1: Illustration of the concept of the NRDP project on digital enterprises

Figure 1 illustrates the concept of a digital, distributed enterprise representing the framework for the research. The vision of Digital Enterprises is to provide a capability to "Manufacture in the Computer". It incorporates a modelling and simulation environment that enables the fabrication/assembly of the products, including the associated manufacturing processes, to be simulated in the computer. This capability takes all the variables in the production environment into account, from shop-floor processes to enterprise transactions, i.e. it accommodates the visualisation of interacting production processes, process planning, scheduling, assembly planning, and logistics from the resource to the enterprise level.

The main characteristics of the project correspond to the above main tendencies:

- *unified management of technical and economic problems* (including concurrent engineering of products and production systems and the vertical integration of technical design and technological levels),
- *purposeful, effective application of up-to-date computerised methods* to optimise and control fast changing complex production structures in an environment full of uncertainties,
- integrated application of *tele-presence* and *interactive multimedia* techniques towards establishment and industrial application of virtual control rooms (VCR), and the involvement of customers into the different phases of design and production processes.

The project has the following - partly overlapping - main directions to be treated in a comprehensive way:

- *Management and scheduling of large-scale projects.*
- *Tele-presence and interactive multimedia.*
- *Monitoring of complex production structures.*

The national R&D project has been started to make all the important production-related information available and manageable in a controlled, user-dependent way by the efficient application of information and communication technologies. The development and application of intelligent decision support systems will help enterprises to cope with the problems of uncertainty and complexity, increase their efficiency, join in production networks and to improve the scope and quality of their customer relationship management.

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