

## **GNOSIS** *a virtual factory*

### **The challenge**

Many European SMEs are already members of manufacturing networks that allow them to make use of each others' specialist skills in distributed manufacturing operations. These networks are usually characterised by long-term relationships between the players, so that each has a clear understanding of the others' resources and confidence in their ability to deliver quality work on time.

Members of these manufacturing networks are potentially well positioned to benefit from the increasing demand for ever more diversified and customised products. However, in a distributed manufacturing operation, it may take some time to determine whether the various players collectively have the skills and capacity needed to deliver the finished product on time, allocate the tasks to the most appropriate players, and manage the workflow within and between the various companies involved.

To maximise their efficiency and competitiveness, the members of a manufacturing network need to operate as a 'virtual factory' that can react quickly to customers' requests. This virtual factory would maintain an up-to-date picture of the skills and available production capacity of the individual players and be able to respond rapidly to orders from customers, allocating and scheduling the individual manufacturing tasks on the basis of available skills and efficient use of resources. It would then monitor the production process and ensure that the order is delivered on time.

### **The technical solution**

The ESPRIT<sup>1</sup> project [GNOSIS](#)<sup>2</sup> developed a system for integrating the resources of several independent manufacturing companies into a virtual factory. The system handled three critical management tasks:

- Product configuration
- Production planning
- Production monitoring

Recognising that small manufacturing companies will only have limited IT expertise, GNOSIS designed the user interface to the system around familiar applications such as e-mail, web browsers and MS Project. An 'Integration Platform' combines information from the individual companies' existing information systems with the virtual factory's own database of skills and resources to drive the configuration, planning and monitoring applications

Orders or product requests from customers are analysed by the product configuration module of the system. This proposes solutions that are based on the manufacturing capability of the virtual factory, based on part and component catalogues provided by the individual partners.

The production planning module tests these solutions against the resources currently available from the various partners. It takes account of all work currently in progress within the virtual factory and produces a plan, which meets the customer's 'required-by' date and optimises the use of the factory's overall resources. This is not necessarily the sum of the partners' resources, because each partner is free to offer a sub-set of its skills and production capacity to the virtual factory.

The individual partners are responsible for dealing with tasks allocated to them by from the virtual factory. and reporting back on expected delivery dates, quality levels, delays, etc. The production monitoring module analyses relevant information extracted from their existing IT systems by the integration platform to track the progress of the order. If it identifies problems, it suggests corrective

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<sup>1</sup> ESPRIT (European Specific Programme for Research on Information Technology) was one of the predecessors of the IST programme. Some of its later projects, such as GNOSIS, ran in parallel with the first IST projects.

<sup>2</sup> GNOSIS was led by the French company ILOG SA and included partners from Finland, France, Germany and Italy. The project started in October 1998 and ended in July 2001.

actions. These involve various levels of escalation, from rearranging an individual company's production schedule to deliver the task on time, to reallocating the task to another company within the virtual factory.

The GNOSIS virtual factory system assumes that the companies involved have established collaboration arrangements, such as call-off orders for small jobs and billing/payment mechanisms for handling such jobs. It essentially offers them a way of integrating some or all of their production capacity into a virtual factory, which can accept orders for jobs that none of the partners could deliver individually. This allows the companies to retain their independence and decide how to split their business between tasks offered by the virtual factory and more conventional contracts that focus on their specific skills.

## The results

The components of the GNOSIS virtual factory system were tested in two trials.

The first involved the Finnish switchgear manufacturer ABB Control Oy and one of its subcontractors SME InCap Electronics Oy. The tests showed that the automatic planing and scheduling facilities were more effective than manual methods and that the system provided seamless information exchange between the main contractor and subcontractor.

The second trial involved a group of Italian metalworking SMEs. The results were evaluated against a set of criteria that allowed quantitative 'before' and 'after' comparisons of, for example, the time taken to transform a customer order into a delivery plan, the number of tasks delivered on time, and the speed of reaction to deviations from the agreed production plan. The evaluation showed that the GNOSIS system significantly speeded up the process of planning a job and allocating production tasks to individual companies. Jobs were also completed more quickly and the system provided early warning of possible problems so that corrective action could be taken before serious delays occurred.

## Conclusions

The GNOSIS system shows how networks of manufacturing SMEs could increase their competitiveness and expand their markets by integrating their facilities into 'virtual factories', which can take on jobs that are beyond the competence of individual network members.

The GNOSIS approach has been developed further in the IST project [PROVE-SME](#), which conducted trials with three Italian and Spanish networks of manufacturing SMEs<sup>3</sup>. The software is currently being developed into a commercial product that will be marketed through Applications Services Providers, who would offer a basic system to an SME network and then configure it to address their collective skills and individual processes.

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<sup>3</sup> The results of these trials are reported in the success stories CORMA, COXA and ETA