KNOWLEDGE-BASED MANUFACTURING : THE KEY TO RECOVERY

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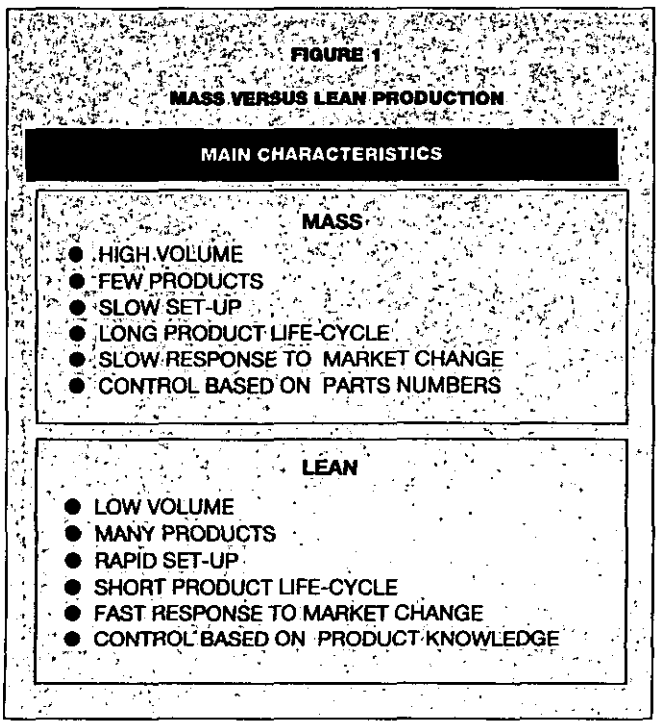
Only companies responding quickly to customer needs will benefit from the economic upturn, but first they must junk their 'dinosaur' MRPII system.

There is of course nothing new in using computers to control manufacturing. Across the world and in all industries, ambitious and comprehensive computerised information systems are playing a key role in all aspects of manufacturing logistics.

Few manufacturers of any size could contemplate, without panic, even a single day's operation without their manufacturing resource planning (MRPII) system to co-ordinate everything from raw materials, work-in-progress, machine capacities, production plans, sales forecasts and stocks of finished goods through to distribution pipelines - the whole A to Z of manufacturing in fact.

But in 1995, as the world economy struggles out of recession, alert manufacturers are beginning to ask whether their existing computer systems are flexible enough for a new era - one in which the consumer is king and when only those companies able to supply the precise product he or she wants, quickly and at the right price, will succeed.

A classic example is the so-called '5-day-car', long talked of by world automotive manufacturers but fast becoming a reality. The concept is a simple one: the consumer walks into a car showroom and specifies on a Monday, the model wanted, along with the colour, trim colour, engine specification, variants and extras. With advanced Just-in-Time (JIT) manufacturing techniques in place and state-of-the-art supply chain systems fully implemented, the car is delivered, exactly as ordered, on Friday of the same week. But for many manufacturers in many industries such an ideal is still far off and their existing computer systems, far from helping are more likely to hinder and delay transformation of the dream into reality.



The problem is that existing MRPII systems were designed for a slower and more static environment - for mass production rather than lean production. With increased emphasis on short production runs of large numbers of product variants, rather than long runs of a few, standardised items, most conventional MRPII systems are taking on a 'dinosaur' aspect. They are too rigid and inflexible for a fast-moving world and many manufacturers fear they are dooming their users to early extinction.

THE PROBLEM : MANUFACTURING BY NUMBERS

At the heart of the problem is the fact that conventional manufacturing systems use manually defined part numbers to identify each unique configuration of finished product, sub-assembly, component part and raw material. Every product variation must have a pre-defined part number, make/buy code, standard (and alternate) bill of material and routing, lead time, standard costs, list price and so on. It is manufacturing by numbers and for companies making a limited range of standardised products, it works well enough.

But many manufacturers have products, components and materials that cannot be managed efficiently by part numbers. This is especially true for variable products that are re-engineered, manufactured or assembled to order, or that have lots of options or a high degree of complexity. Products like this can generate thousands of unique variations, any one of which might be ordered by a customer at any time. And the variability has an impact down to the level of raw materials.

When the cost of maintaining a manufacturing system outweighs the benefits it provides, informal systems take over. Key business functions are supported by these informal procedures, which are prone to error and mis-interpretation.

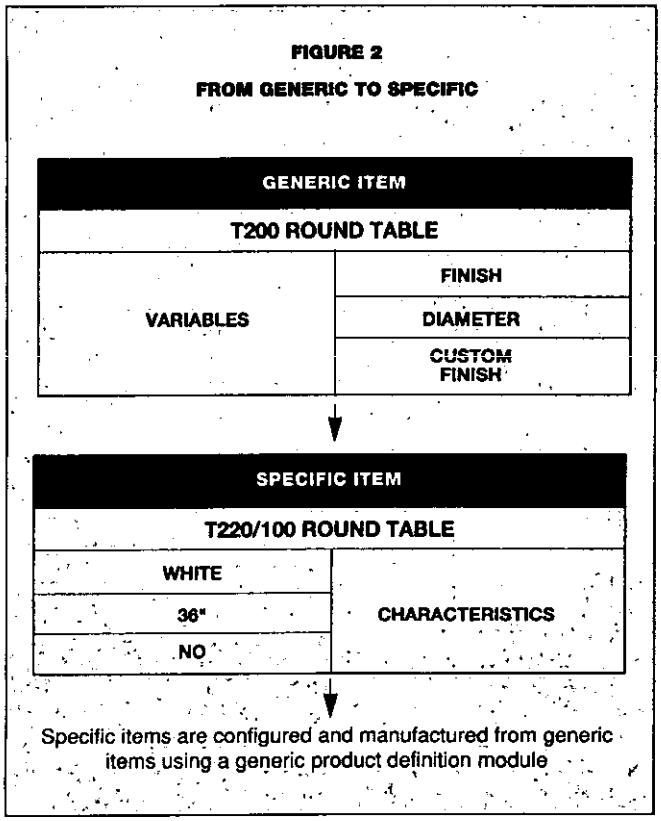
In companies that rely on such informal systems the employees must control the manufacturing process and the acquisition of materials, because there is no central database that contains detailed product information. Until now these manufacturers have been unable to take full advantage of the tools that have helped other industries with their manufacturing processes.

Rules-based 'configurators' have been developed to address these needs, but they tackle only the front-end, order entry problem; they do not address downstream problems in materials planning, production and engineering. They also rely on in-depth operator knowledge about allowable combinations and option dependencies.

THE SOLUTION : KNOWLEDGE-BASED MANUFACTURING

The solution is a new approach to manufacturing systems, one that allows businesses to manage highly variable products by product knowledge rather than by part numbers. Knowledge-based manufacturing is a way of automating people-based product knowledge and making it available to every functional area of the business.

In knowledge-based manufacturing, parts and products are identified not by part numbers but as generic items. A generic



item is a logical group of products, components or materials whose individuals units (configurations) differ only in size, colour or other variables. A generic item is not manufactured. Instead, it serves as a template for all the possibilities of parts and options for an item, including rules and conditions that must be tested for each configuration. The system can then configure variations as needed for costing, pricing, manufacturing, purchasing and other functions.

At a furniture manufacturers, for example, the T200 Round Table might be a typical generic item; so are the legs and top for this table. Although dozens of unique configurations can be ordered and manufactured for this product, only one set of information will need to be maintained for all T200 units. Stocked components, raw materials and purchased parts can also be managed generically.

The T200 table is a simple example, but the same principles can be applied to almost any product, regardless of complexity.

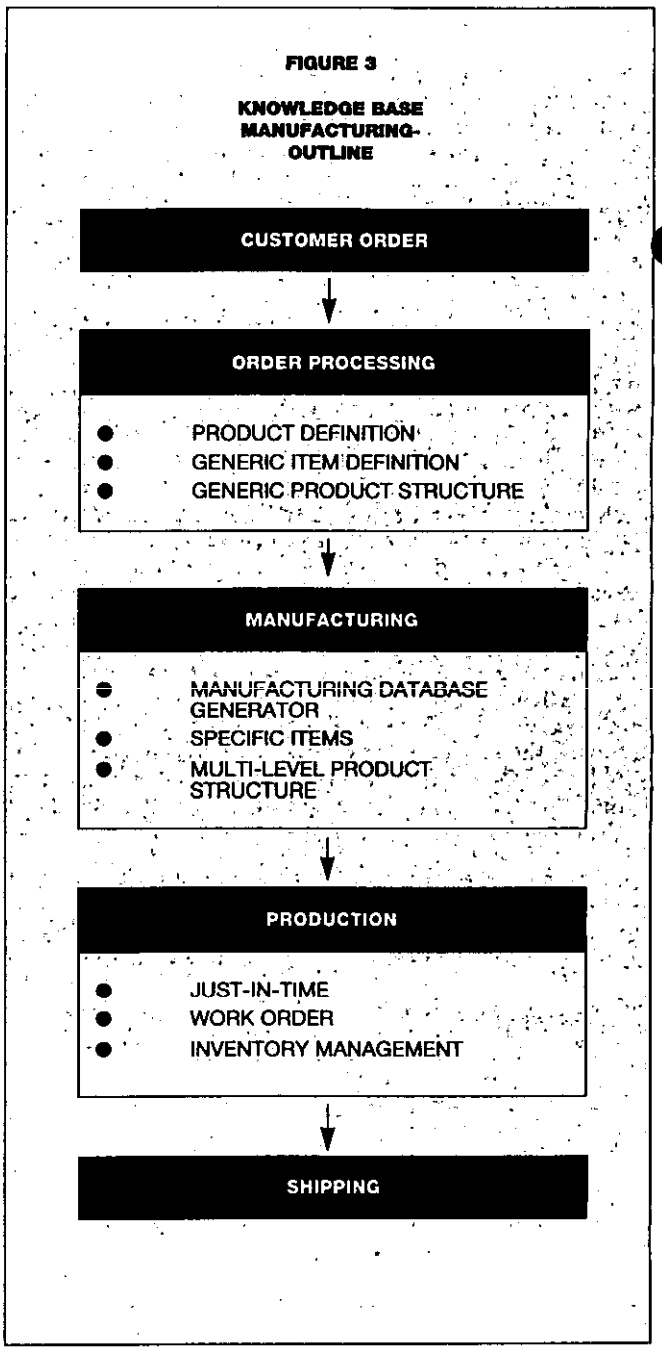
A CLOSED-LOOP MRPII SYSTEM

Today, new knowledge-based computer systems for manufacturers are beginning to emerge, systems which build on these principles and in some cases take them even further: by integrating a rules-based product manager with a closed-loop MRPII system, the well-established principles of MRPII, which have proved their value for producers of standardised products, can be successfully applied by makers of complex, varied and make-to-order products.

From the information you supply to the generic product definition module, a knowledge-based Manufacturing Database Generator creates a full production database in the form of item records - all the data needed to manage each new configuration, including definition and planner data, costing and pricing formulas - and a fully costed, 100% accurate multi-level bill of material for every valid product configuration.

Products manufactured following the knowledge-based approach, rather than the rigid parts numbers style of traditional MRPII, can be configured and costed from several places in the system, including Inventory Management, Sales Order Management and Purchase Order Management. New configurations can also be created independently with a specific 'item create' option, which is useful for building up the production database with standard, frequently ordered configurations and with make-to-stock items and buy-to-stock items. Also available is a cost sheet that produces a fully costed multi-level bill of material report for 'what if?' simulation of a new configuration and then immediately purges the details from the system, should the configuration have unacceptable implications (for profitability, for example).

Let's look in a little more detail at how the system works.



Generic Item Definition

In a knowledge-based MRPII system, each generic item is linked with a set of properties, variables like 'finish', 'diameter' and 'weight'. Once values have been assigned to these properties, the result is a set of property values; the characteristics of the specific item.

The properties defined for each generic item provide the knowledge or 'working information' that is used for the item throughout the company. Properties also provide for the creation of a flexible database that can handle all the information unique to an industry, a set of products and a set of materials.

Generic items can further be defined by various kinds of rules (formulas) for such things as generic cost, generic price and generic planner information.

Generic Product Structure

Generic product structures link generic parent items to generic component items or ordinary component items (part numbers defined through the Item Definition Maintenance and Planner Data Maintenance options).

Instead of constant values (quantity per = 1, scrap factor = .05, component length = 18 3/4'), generic product structures make it possible to use formulas that are analysed based on the values assigned when the product is configured.

Component characteristics (finish, length and so on) can be

(1) determined directly from the parent (for example, finish of the component = finish of the parent); or

(2) calculated based on one or more properties of the parents (for example, length of the component = width of the parent divided by 12).

Component conditioning allows a relationship to be included in or excluded from the bill of material based on characteristics of the parent (for example, include this relationship only if parent's height is greater than 48').

Generic product structures can be used for both make-to-stock and make-to-order products. In make-to-stock environments where the products have variables such as size and colour, generic product structures can reduce from months to days the effort required to introduce an engineering change. For make-to-order environments, generic product structures provide the item records and product structures that were previously unavailable.

Database Maintenance

An effective knowledge-based system must include a tool that automates database maintenance. Generic items can be used as templates to create all parts and bills of material, using the same functionality used to create configured customer orders. Most important, the system can efficiently and consistently apply engineering changes to all variants of a generic item and its associated product structures.

INTELLIGENT MANUFACTURING

By incorporating intelligence into a manufacturing system, knowledge-based software offers the opportunity to streamline, improve and tailor business processes.

Product maintenance is easier because generic items and generic product structures are the means of generating and maintaining the database. New items are configured using generic items as templates. Engineering changes to a generic item are propagated automatically to all configurations.

Order entry and quotations become easier because operators are guides through selections to define a valid configuration. Remote order entry from sales representatives, distributors and even directly from the customer's planning system becomes feasible even for the most complex products.

The configurations generated by customer orders can be used to create a dynamic business plan. Companies with short manufacturing cycles can generate production schedules at the group level while monitoring actual production for both the product group and specific configurations. Production schedules can be organised by product group and characteristics to optimise production scheduling.

These operational benefits can help companies respond better to customers. Knowledge-based manufacturing simplifies processes for the end user - and simpler processes mean faster responses, more flexibility, shorter lead times and a more cost effective operation.

About the Author

Tim Foxlow is National Sales Manager for Hoskyns Industry which serves manufacturing and process industries and the privatised utilities. He is responsible for the sale of KBM Knowledge-Based Manufacturing software, other applications software for manufacturing and a range of computer-based services extending from consultancy and systems integration to facilities management and automation and control projects.

Before joining the computer services industry, Tim spent 12 years in industry including several years at Sheffield steel producers Johnson Firth Brown where he rose from the shop floor to production manager. He holds an honours degree in Manufacturing Systems from Sheffield University.