



THE NATURE OF COMPETITION: MASS CUSTOMIZATION

Designing the ideal delivery system for your operation

Configuring the factory for mass customization



> By Eberhard Reyer

Today, designing the factory for the future is a serious engineering and technology challenge. It has really evolved into an artful translation: listening carefully to what customers want and converting that into an integrated business system that satisfies them efficiently, quickly and profitably.

Customer expectations for color, style, features, options, dimension, functionality, quality, price and delivery influence not only product design, but reach all the way to the factory floor.

Markets, products and production processes are inextricably linked into a single system and influence how we design our products and the factories in which we produce them. In this article, we will consider how, in the mass-customization business model, market factors, product design, product engineering and process design all influence the configuration of the factory floor.

THE PERSONALIZED MARKETPLACE

Clearly, customer demand for individualized product is dramatically increasing the complexity of our businesses and consequently the complexity of our factories. This is particularly true when it comes to creating information and fulfilling orders for customized product.

Add to that, the increasing intensity of the competitive landscape. The globalization of manufacturing markets, free trade agreements, high shareholder expectations, high structural costs in developed economies, high labor costs, equalization of mechanical advantages, and technology migration continue to exert tremendous pressure on industry companies to compete.

Manufacturers look for new ways to compete. They introduce new product, invest in new equipment and software. They build new factories. They implement Lean. All for the sake of improving their competitive edge. But, in the end, in spite of heavy capital investment, our factories struggle for a competitive foothold.

This fact is due, at least in part, to our linking investment to capacity rather than business strategy. And in doing so, we look for shorter machine cycles instead of thinking in terms of shorter customer delivery cycles. In other

words, we limit our discovery of the full potential of the competitive power that comes from leveraging product and process with technology. This potential is driven by the expansion of manufacturing and information technology.

The migration of technology from mechanical to electronic has driven capital improvement in the wood industry over the past 15 years, impacting the design of our factories. Developments in information systems and data integration have had a remarkable impact on our ability to align manufacturing capability to the demands of the market place. In combination with advances in wood and panel processing machinery design, these developments now comprise the key elements for the mass-customization factory.

Still, these advancements have not been fully leveraged for mass-customization. Why? For two reasons. First, manufacturers continue to regard

they purchase your product, and how they use it. The attributes of a product platform include size, shape, materials, connectors, and quantity. These attributes directly influence the manufacturing model, machine specifications, work envelopes, workflow, plant layout, and other organization design.

Construction principles are a set of engineering rules that determine how a product platform is assembled, that is, the joinery. Construction principles can be shared by platforms, but platforms never have more than one construction principle.

These product rules are the basis for mass-customization. They are defined in the engineering configurator and enable dynamic generation of manufacturing data for customized products. Furthermore, they provide the basis for machine specification, assuring that what can be engineered by the configurator can be produced. This

is the most important success factor in creating a process for mass customization: the correct selection of product and production principles that create alignment between product, engineering, manufacturing and distribution.

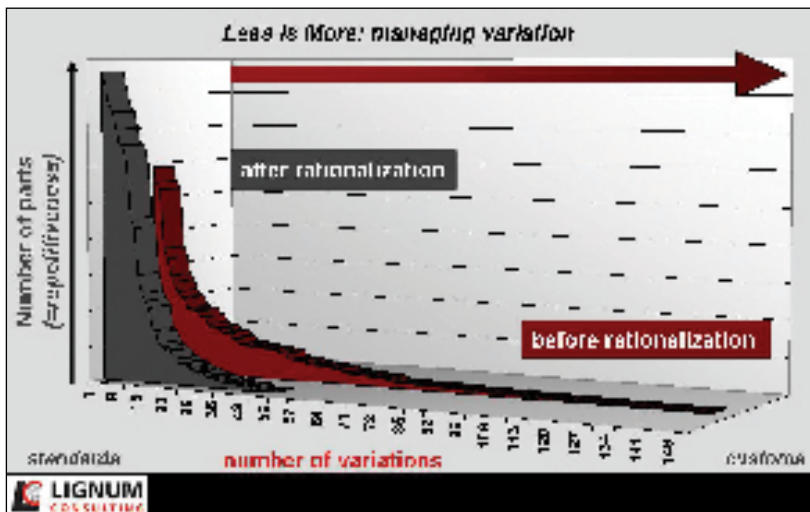
These principles reduce the number of parts, and consequently, manufacturing com-

plexity, while increasing the number of finished goods available for customers. This “less is more” approach is the essence of mass customization, but is only possible through rational product platforms based on engineering principles that are rooted in process capability and workflow.

THE RATIONALIZED FACTORY

As with products, the layout of the factory begins with a set of design principles. These principles guide the development of the plant and ensure its alignment to the business strategy:

- process design defines plant layout;
- market strategy defines process design;
- manufacturing execution system controls the process;
- product and engineering data drives the manufacturing execution systems; and
- configurators create product and engineering data.



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product development and factory engineering as two separate functional activities rather than as an interdependent process between marketing, product design and engineering, and operations. Second, manufacturers fail to recognize the migration of information technology in manufacturing systems, and the level to which it is now possible to integrate the factory floor to the rest of the business. Manufacturing systems can now dynamically interact with engineering configurators that manage product engineering, and manufacturing execution systems that manage order fulfillment.

THE PRODUCT DESIGN

The bridge between customer demand and an efficiently operating plant is a rational product platform and construction principles. The platform is designed around the range of product variability your customers expect, how

These rules force plant layout to begin at the “global” level. This ensures a broad, holistic view of the product, process, and information systems. Fundamentally, the manufacturing process design is at the core of creating the layout of the plant. This process design is the manufacturing model by which products are produced by your company — your specific approach to processing.

The manufacturing model defines how production is organized, scheduled, laid out and controlled. It addresses questions such as “do we make to stock, make to order, or both?” The manufacturing model considers the implications for:

- capital requirements
- manufacturing lead times
- space requirements
- work in process
- finished goods requirements
- productivity
- flexibility

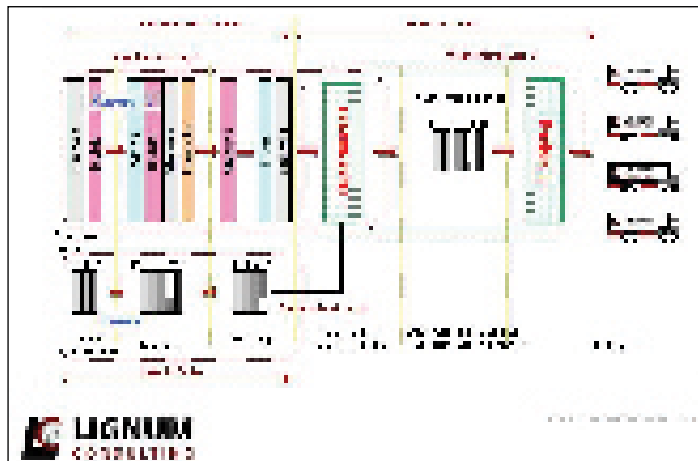
Manufacturing models must accommodate the variety of manufacturing demands, such as order quantity. Since mass customization typically affects some but not all products, many manufacturers will require mixed models. That is, they may need a mix of both volume and semi-custom capabilities. Since the drivers for demand may come from differing sources — or have differing internal lead times — they may require independent processing resources.

In a mass-customized environment, the manufacturing model is typically characterized by two conditions: clearly defined production “loops” and flow or “discreet lot size” manufacturing capabilities. A production loop is simply the underlying logic for organizing or grouping production processes. The organization of processes is based on the attributes of the component or assembly, not on its description.

For instance, a production loop may be defined as being where we process all panels requiring 2mm edgebanding rather than the cell where we process panels that are classified as fronts. Since certain fronts may require differing processes, the definition by attribute will provide a more accurate description of the process requirements. Alternatively, we may have other components that have the same processing requirements that are not classified as fronts.

Production loops can be single machines, cells, or groups of cells. The key idea is that production loops group like process requirements. In the diagram, above, one loop is defined as the ‘machining’ loop. Here all processes that precede assembly are grouped together. Within this loop, there are internal process loops, such as the customization area, where processing is isolated and tracked separately from other processes.

In many instances the logic of a production loop can be defined by attributes such as internal lead times, order quantity, material type, or



Organizational “loops.” (Copyright of Lignum Consulting 2006)

required skill level. These considerations take into account the unique process requirements of a specific component, and when coupled to the manufacturing execution system, provide both a high level of planning control and feedback from the production floor that is based on actual plant behavior.

In any case, the layout of the plant is first the result of understanding the specific process requirements of your product platform, then designing the organization of processes around that understanding. Once this process design is in place, plant engineering and layout can begin.

Plant layout begins with the interpretation of these production or organization loops into specific work cells or flow systems. The design of the cell or system is based on the manufacturing strategy that most efficiently utilizes existing process resources and capabilities. These cells are designed first as flow models, then as engineering models. The first visualizes and qualifies the concept, while the latter precisely documents and quantifies capacity, throughput, quality, and cost assumptions.

Ultimately, the final plant design is the end, not the beginning, of the process. It is the sum of understanding customers, markets, product, process, and technology. In the past, many manufacturers have decided to buy a new machine or build a new factory. In many cases, that decision is made well ahead of a deep understanding of what problem we are really trying to solve for our customers and our shareholders.

In a manufacturing model based on mass cus-

tomization, the design of the factory is the result of this understanding, not the cause of it. Manufacturers intending to shift their model will need to invest time, energy and money in building the knowledge base from which they will redesign not only their factories, but their business.

Mass customization offers manufacturers a way to counter the mounting pressures of the competitive market place. It can create real value for individual customers and real competitive differential for woodworking companies. The journey is not an easy one, but configuring the factory for mass-customization may just be the best route to a competitive and sustainable future.

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