The manufacturing beat

Manufacturing within ABB

Steven Hegyi

For many years, ABB has been known as an engineering company. Its reputation for finding solutions to a host of challenging customer issues is well known. What is not often recognized is that ABB is also a manufacturing company with about 260 factories and production centers around the world. These factories range in size and product scope from small assembly and test centers focused on serving local markets to global focused factories with world wide product scope responsibilities. The following article takes a brief look inside some of ABB's factory types.

ABB has many factories making a variety of different products 1. The manufacturing capabilities, production methods and business systems used in these factories also differ. While it is important for our customers to see the company as "one ABB", it is equally as important to understand this does not mean every single factory should be the same. This is because products differ in complexity and production volumes. Some factories produce high volume, low complexity products based on one basic design or design family while others make low volume, highly complex engineer-to-order products and solutions. Some are assembly and test plants that are highly dependent on outside suppliers while other factories have a high degree of vertical integration and make many of their key components. Thus, the challenge lies in determining how best to manage these differing production systems.

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Manufacturing processes are changeable and can be compared to the flow of water in a river: sometimes production is fast and sometimes it is slow. Sometimes production flows smoothly whereas there are times when obstacles block or slow the entire process down. One way to measure the efficiency of production flow is called "inventory". Fast processes have low inventory as a percentage of revenue while slow processes have high inventory. However, as is well known, inventory can be very expensive in terms of cash, warehouse size, poor quality, and management time and effort. Therefore, to minimize inventory, production flows must be optimized along with the supplier network connected to them. This requires an acute understanding of production flow characteristics before the optimization process begins.

The relationship between product complexity and production volumes can be classified into five basic types of production flows 2 3:

- Job Shop
- Batch Flow
- Operator Paced Line Flow
- Equipment Paced Line Flow
- Continuous Flow

These flows also represent the type of factory layout and management system that should be used for production planning and execution. This includes: process shops that are dedicated to one type of component or part; work cells where both workers and product move to work stations or machines in a pre-determined pattern depending on the product requirements; production and assembly lines dependent on either workers or machines to pace the production flows; and production lines that are dominated by closely interlinked equipment.

But the real challenge is determining how manufacturing should be run.

Each factory has a definable "beat" or in other words the pre-determined pace or rhythm that defines the maximum speed (and efficiency) at which material and work flow through the manufacturing process. In many cases, this beat can actually be heard. Different types of factories have different beats thereby necessitating different types of systems to optimize work flows. All too often however, the way factories are run is determined by Enterprise Resource Planning (ERP)[1)] and/or "standardized" systems based exclusively on financial reporting desires or common IT platforms. And this can be a problem.

Job shop factories

At one time, ABB had hundreds of small, low volume job shop factories making products for local markets. These job shops typically produced

Footnote

[1)] see glossary on page 74.

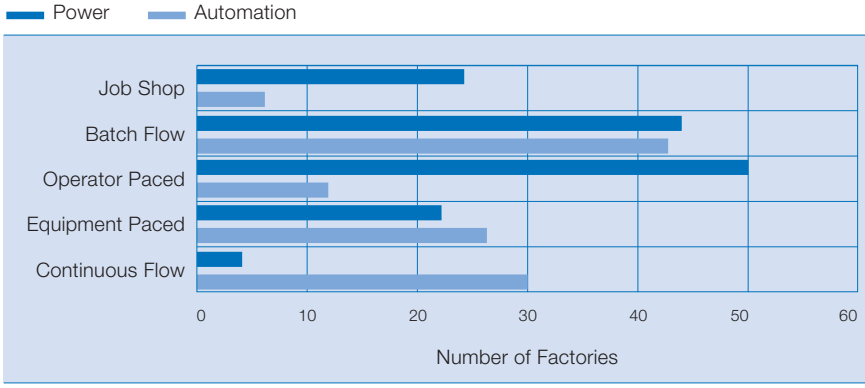
1 The size and scope of manufacturing in ABB

ABB is a large manufacturing company
- Automation products
  - 1,000,000 products/day
- Power Products
  - 1,000,000 products/year MV
  - 10,000 products/year HV

Large number of factories and software production centers
- 260 factories
- 140 software centers

Products rage from
- Complex Engineering-to-order products and systems
- Assemble-to-order configurations
- Standard catalog items

2 Production flow factory types within ABB's Power and Automation businesses



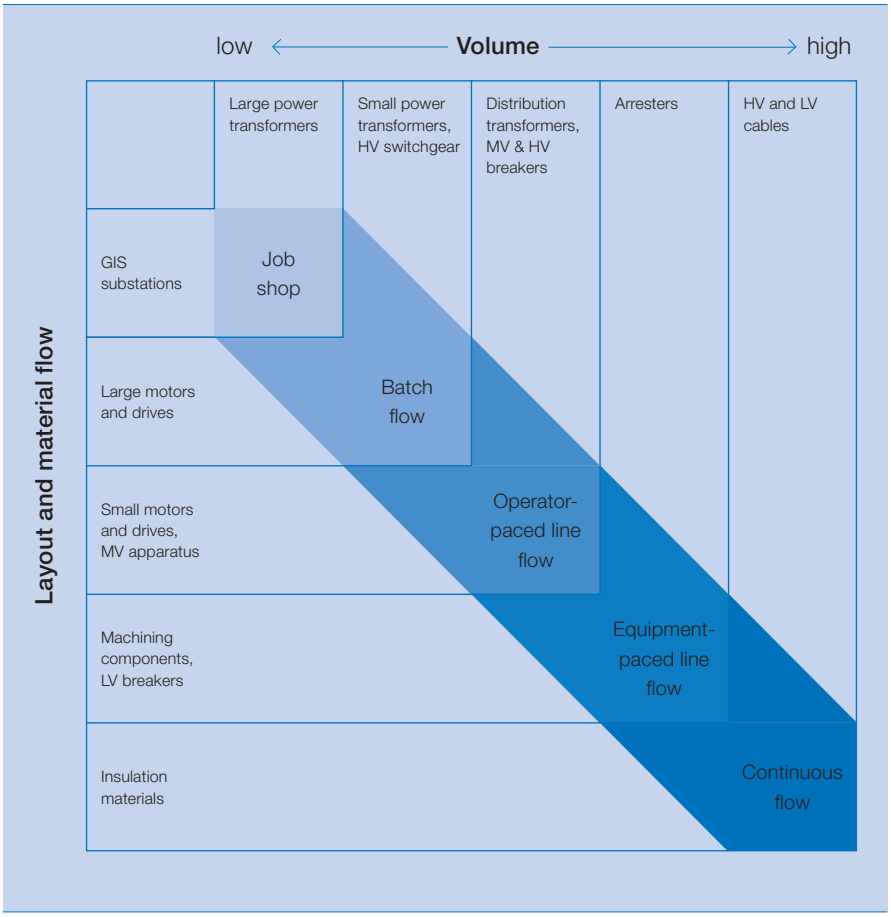
engineer-to-order products with a high degree of customization and complexity. Each customer order was a project and most required non-standard functionality or unique parts and components that put a heavy demand on Supply Management and Production Control. In a "job shop" factory, each part and component has to be individually planned, scheduled, ordered, processed and tracked in manufacturing. ABB's large power transformer manufacturing plant (within the company's Power business), in Bad Honnef, Germany is a perfect example. This factory produces only 50 to 60 transformers per year but each unit is a unique project requiring hundreds of hours of engineering design and thousands of labor hours in manufacturing. This is very similar to the robotic system integration factories within ABB's Automation business. ERP systems using Material Resource Planning (MRP)[1] II are adequate in these situations although in larger factories the number of people needed to render them effective is usually quite large.

Batch flow factories

ABB shifted to the Focused Factory concept in the mid to late 1990s. This involved the redesign and simplification of many products and product families and the rationalization and elimination of numerous factories. By specializing (or focusing) a number of job shop factories on a limited number of complex and engineer-to-order product types, factory volumes were increased and throughput times shortened. Customer orders with the same or similar design requirements could now be grouped in manufacturing, and processed at the same time in "batches" instead of one at a time. This type of manufacturing can be found in a number of ABB plants including: the New Berlin, Wisconsin factory for drive systems (Automation business); the Lake Mary, Florida plant for MV switchgear; and the Lodz, Poland insulation kit center. In each case, products are designed to customer specifications even though hundreds are produced in the end.

Robot and large distribution transformer manufacturing are other good examples. The batching of products is important because it enables a factory to be arranged into "cells" of different types of machines – or work stations – for increased efficiency with less work-in-process inventory. Batch flow production starts within an individual cell then moves to other production cells or areas within the factory depending on the product design requirements. Traditional factory planning and scheduling tools can be severely tested using this concept, although some modified and customized systems in ABB have proven very effective. Planning and factory management systems based on Theory of Constraints (TOC)[2] using bottleneck management techniques have also shown potential but the wide variations in product complexity and work content are a definite challenge when used exclusively.

3 Five types of production flows (or manufacturing processes) classify the relationship between product complexity and production volumes



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Operator paced flow factories

As the complexity of products and production decreases, standardization of parts and components increases and the manufacturing work content becomes more uniform. Products are built on higher volume assemble-to-order production lines. This type of manufacturing is very common in ABB, especially in the group's Power business. ABB's MV apparatus manufacturing in Dalmine, Italy and the distribution transformer plant in Jef-

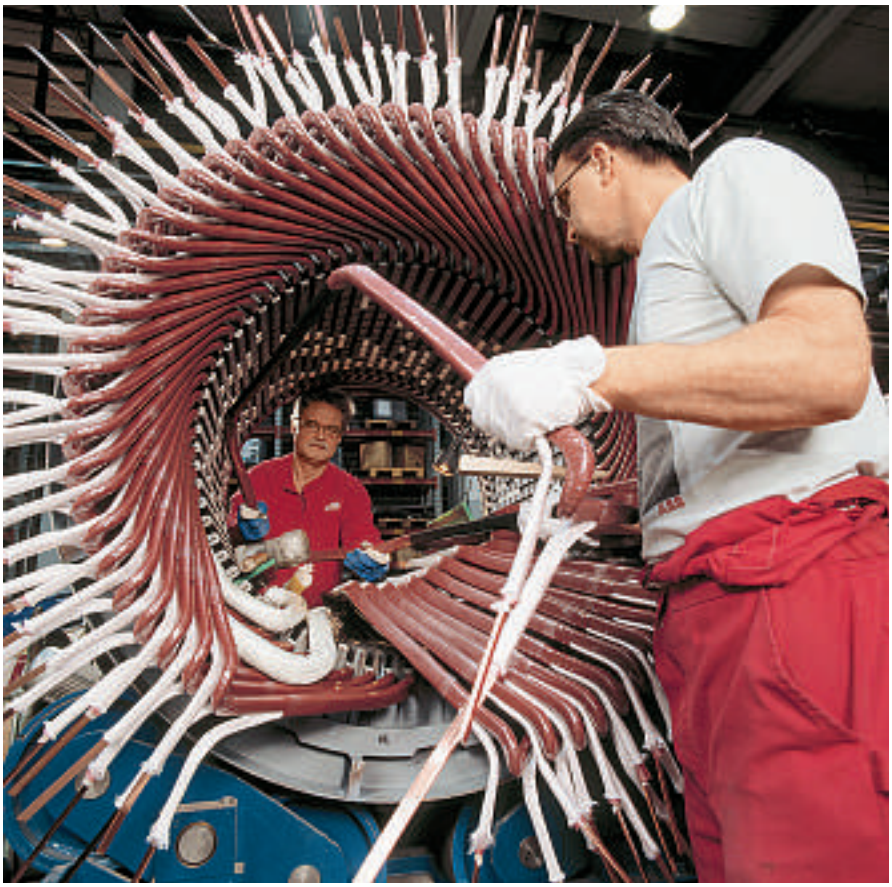
Footnotes

[1] see glossary on page 74.

[2] see textbox on page 25.

ferson City (Montana) are excellent examples. Production volumes in both plants extend into the thousands.

Automation's LV switchgear plant in Bergamo, Italy is another example. The pace of production is controlled by individual workers or work teams. Bottlenecks or production constraints are readily identified by a build up of work-in-process (WIP)[1)] inventory at a few key stages of production. The key to operator paced manufacturing is to keep a constant tempo or pace throughout factory. This constant pace not only facilitates the optimization of resources in the factory and simplifies the overall production planning process, but it also enables much of the plant's inventory to be managed through the use of kanbans and Just in Time (JIT) supply. In fact, by using a "pull" type production system (one out, one in) and applying TOC concepts, some ABB factories have virtually eliminated the need for detailed planning and scheduling of many of their factory processes.



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Equipment paced factories

Equipment paced production systems are similar to operator paced manufacturing but are much faster, have higher volumes, and less product design complexity and variation. Most parts and components have been standardized. Automation plays a major role and workers are paced by the speed of the machines. Product designs are fairly uniform in the sense that they all require the same amount of machine and/or labor time, and most client customization takes place at the end of the production line. Again, bottlenecks or constraints in manufacturing can be easily identified by WIP inventory in front of a process. Examples of this type of manufacturing in ABB include LV breaker manufacturing in Germany and Sweden's HV surge arrestor plant where hundreds of thousands of products and components are produced. Pure pull production systems excel in machine paced factories and TOC production planning is most effective.

Continuous flow factories

Continuous flow production systems are characterized by uniform designs with very high production volumes. Paper insulation manufacturing in ABB Pucaro is an excellent example. These factories make essentially one type of product or product design and operate 24 hours a day, 6 to 7 days a week. Production is continuous as it flows through the factory. Factory optimization is achieved by maximizing machine utilization. There is usually little actual in-process inventory, and JIT supply of raw materials is very common. Machine stoppages are deadly in this type of manufacturing, so preventive maintenance is a dominant factor in the production planning process.

ABB has many factories making a variety of different products. Success factors for managing and optimizing these factories dictate a clear understanding of the type process flow within manufacturing.

One size definitely does not fit all.

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