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Link Process, Product and Market Life Cycles

All living organisms go through changes with regularity as they grow and develop. During a life cycle, an organism goes through physical changes that allow it to reach adulthood, maturation, decline, and finally death. These changes are common within species, and they can be grouped into stages of development. Many attentive observers have attempted to apply the same principles to companies and many industries.

In this article I will show that the process/product/market life cycle pattern is a general rule and applies to almost all the manufacturing industries. It does provide a useful and provocative framework for thinking about the growth and development of a product, a process, a market, a business, a company, or an entire industry. One of the major shortcomings of the previous approaches, however, is that it concentrates on the marketing implications of the life cycle pattern. In so doing, it implies that other aspects of the business and industry environment move in concert with the market life cycle. While such an approach may provide a framework to think back on the kinds of changes that occur in different industries, however, at least manufacturing companies will often find it too simplistic for use in its strategic planning. I believe, in fact, the concept is quite misleading in strategic planning.

I am suggesting that connecting the market life cycle concept with product life cycle as well as a related but distinct phenomenon that was introduced as the process life cycle (Robert H. Hayes and Steven C. Wheelwright, HBR 1979) facilitates the understanding of the strategic options available to a company, particularly with regard to its manufacturing function.

The Product-Process-Market Three Dimensional Matrix

The process life cycle or technology life cycle has been attracting increasing attention from technology-driven businesses over the past three decades. Just as a product and market pass through a series of major stages, so does the production process used in the manufacture of that product. The process evolution typically begins with a “fluid” or “disorderly” process—one that is highly flexible, but not very cost effective—and proceeds toward increasing standardization, methodization, computerization, and automation. This evolution concludes in a “continuous process” that is very cost effective

but with high “capital intensity”, organized, and hence less flexible than the original fluid process.

The product development usually starts with high variety products with high “product diversity”---- and progresses toward few major products, and low product diversity. This evolution terminates in a “one of a kind” commodity product with unit product diversity.

The market advances through “start-up” with low sales volume--- and progresses to higher volume “growth”, “established”, “expansion” and “maturity”, and finally lower volume “decline” stages.

Using a three dimensional product-process-market matrix, Exhibits I, II and III suggest three surfaces showing interactions of the product and process, product and market, and process and market life cycle stages, respectively. The rows of the process-product matrix in Exhibit I represent the major stages through which a production process tends to pass in going from the fluid form (low capital intensity) in the top row to the continuous form in the bottom row (high capital intensity). The columns represent the product life cycle phases, going from the great variety (high product diversity) associated with startup on the left-hand side to standardized commodity products (unit product diversity) on the right-hand side.

The rows of the market-product matrix in Exhibit II signify the major phases through which market tends to pass in going from low volume sales associated with “start-up” to high volume sales in the “mature” stage. Finally, the process-market matrix in Exhibit III displays the sales volume in various stages of process development. It is important to note that these exhibits reflect the intersection of a football shape volume with three surfaces.

Capital intensity is defined as the ratio of total assets to the sales. The product diversity is a new concept and is defined as the average number of products manufactured by a capital structure which is a set of equipment needed to perform a process or a group of similar processes. A plant consists of related production facilities at a site. Plants designed for flexible operations contain several capital structures which produce similar products and may share processing steps. Just imagine a car plant manufacturing different brands in several assembly lines. Assembly line A is dedicated to a popular brand. Assembly lines B and C produce 2 and 4 brands, respectively. The product diversity for this plant is 2.33 ((1+2+3)/3). Similarly, product diversity for a business unit or company is defined. The market life cycle is measured by sales volume. The profitability is defined as the operating profits over sales volume and is shown next to the company labels.

Sales, total assets, operating profits were taken from companies' annual reports and 10 K forms. Product diversity was obtained from ChemPlan, invented by Ali Amirnazmi, the founder of the company. ChemPlan is a powerful, knowledge-based fully-linked relational/hieratical chemical database with extensive, multifaceted library covering all aspects of a chemical. This subscription-based system contains more than 6,000 products, 7,000 plants, 6,000 processes, and 500 markets in over 1,100 applications, with over 35 multinational chemical companies as participants in the program. ChemPlan is employed for competitive cost analysis, project evaluation and selection, product/process/ market/business development, cost/performance ratio analysis, acquisitions and divestitures, joint ventures, technology selection, licensing, technology and site-specific cost comparisons and three dimensional product, process and market life cycle profit/loss analysis. Capital structure information are mostly based on environmental protection agencies data. For more details, please refer to www.chemplan.biz.

Football Profitability Volume

A company (or a business unit within a company) can be characterized as occupying a particular place in or outside the football (ellipsoid), hence, in or outside its intersections (ellipses) in the three matrixes, determined by the stages of the product-process-market life cycles. In a company positioned lower at the left-hand corner of the matrixes, each job is unique and a jumbled flow or job shop process is selected as being the most effective in meeting multiple products and low sales volume requirements. In such a job shop, jobs (product orders) arrive in different forms and require different tasks, and thus the equipment tends to be relatively flexible and general purpose. Also, equipment utilization is low, the workers typically have a wide range of production kills, and each job take much longer to go through the plant.

Further up in these matrixes, the production structure characterized as batch or disconnected line flow process. Economics of scale in manufacturing usually lead such companies to produce fewer products per unit of operation than the previous example. This enables manufacturing to move from a job shop to a flow pattern in which batches of a given products proceed irregularly through a series of work stations, or possibly even a low volume assembly line to meet higher volume sales.

Even further up, for a product like specialty chemicals or automobiles, a company will generally choose to make only a few products per unit of operation and use a relatively mechanized and connected production process, such as a moving assembly

line. Such a process matches the product and market life cycle requirements that the companies must satisfy with the economies available from a standardized and automated process.

As we move to the upper right-hand corner, the most economical method of production for the company is continuous flow, dedicated to manufacture a product such as commodity chemicals.

Included in these matrixes are mostly chemical companies from around the world. Also included are companies from other sectors such as oil, biotech, machinery and power generation industries.

Based on analysis of these matrixes, one can make several valuable observations. Firstly, there is a direct correlation between profitability and the closeness to the diagonal. Secondly, the most important matrix is the process-product matrix. When the company's manufacturing process is in sync with its product type, its business is more profitable as long as it falls within the football field. Thirdly, at the lower left-hand and upper right-hand corners, there is much less maneuverability room for the company to keep its business profitable. Finally, the best location for maximum profitability is the center in the football when process, product and market structures are all synchronized. At this location, a company can move up, down, right or left without jeopardizing its profitability.

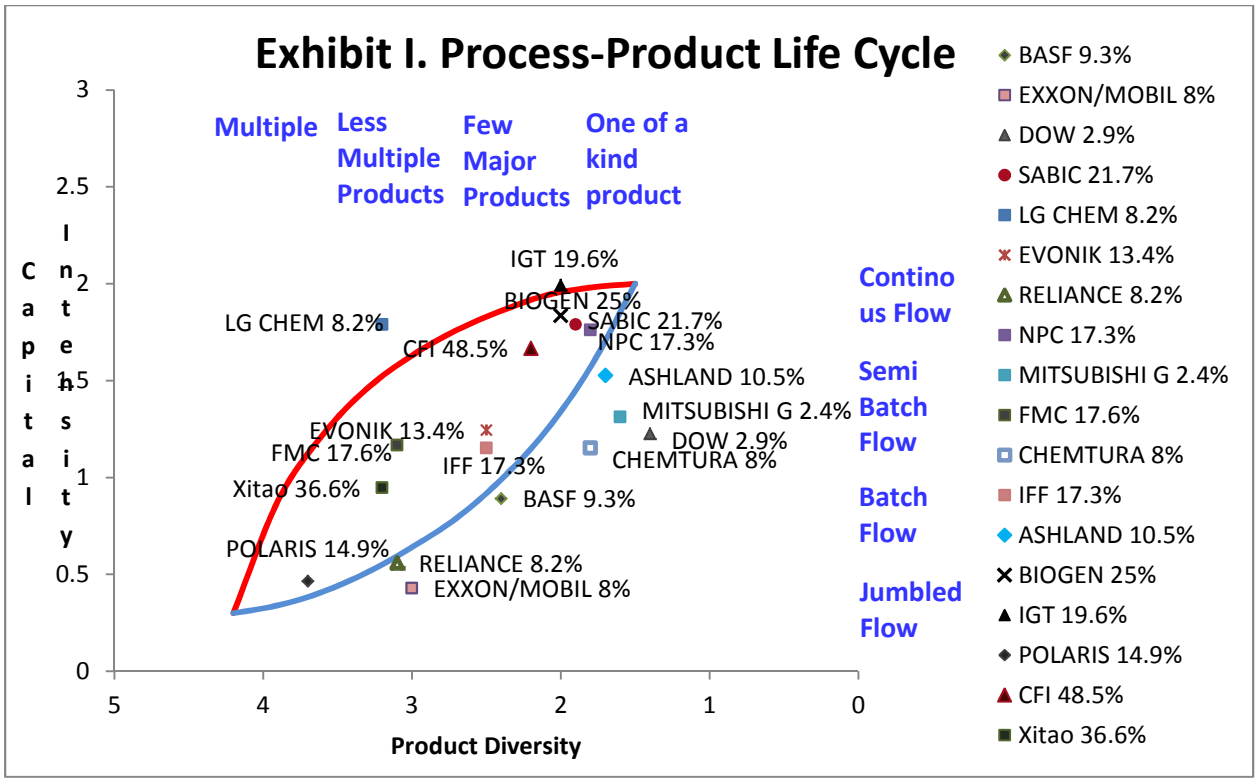
Exhibit I. Process-Product Life Cycle
Multiple
Less Multiple Products
Few Major Products
One of a kind product
Capital Intensity
Product Diversity
Continous Flow
Semi Batch Flow
Batch Flow
Jumbled Flow
IGT 19.6%
BIOGEN 25%
SABIC 21.7%
NPC 17.3%
LG CHEM 8.2%
CFI 48.5%
ASHLAND 10.5%
MITSUBISHI G 2.4%
DOW 2.9%
EVONIK 13.4%
FMC 17.6%
IFF 17.3%
CHEMTURA 8%
Xitao 36.6%
BASF 9.3%
POLARIS 14.9%
RELIANCE 8.2%
EXXON/MOBIL 8%
BASF 9.3%
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DOW 2.9%
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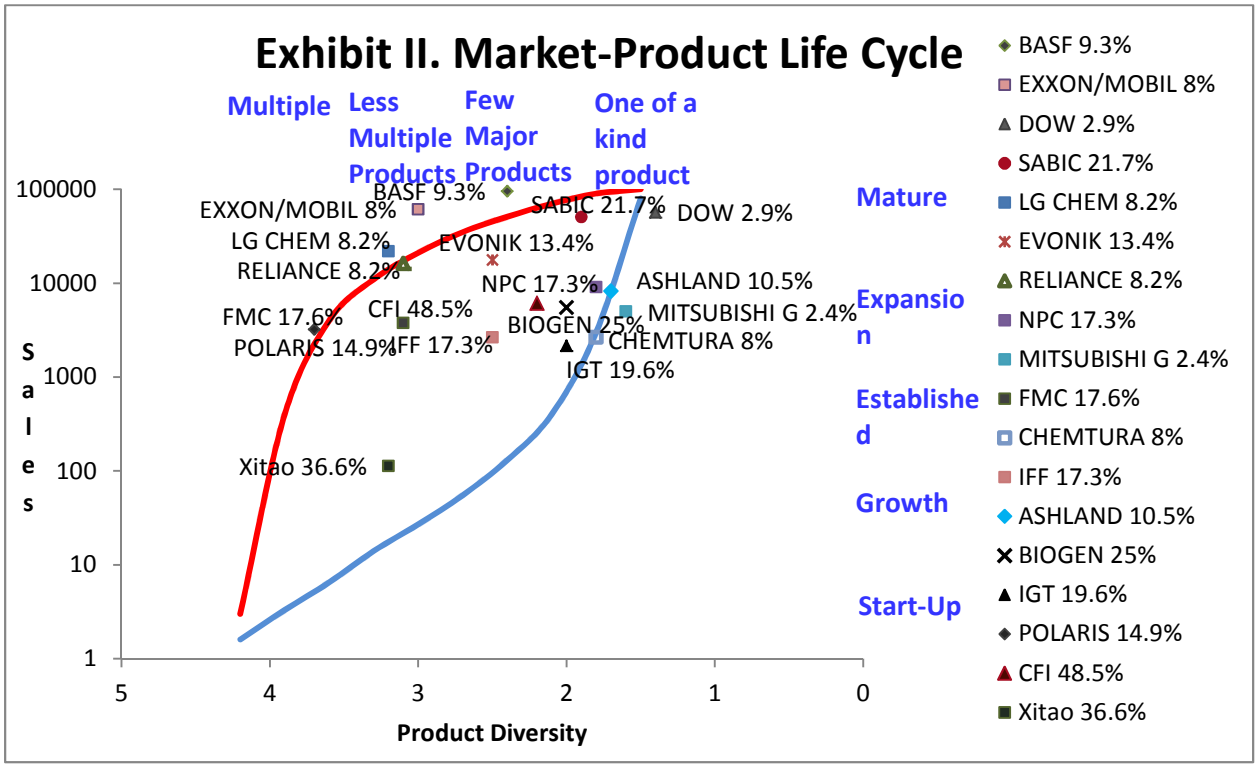
Exhibit II. Market-Product Life Cycle
Multiple
Less Multiple Products
Few Major Products
One of a kind product
Sales
Product Diversity
Mature
Expansion
Established
Growth
Start-Up
BASF 9.3%
EXXON/MOBIL 8%
SABIC 21.7%
DOW 2.9%
LG CHEM 8.2%
EVONIK 13.4%
RELIANCE 8.2%
NPC 17.3%
ASHLAND 10.5%
FMC 17.6%
CFI 48.5%
MITSUBISHI G 2.4%
BIOGEN 25%
POLARIS 14.9%
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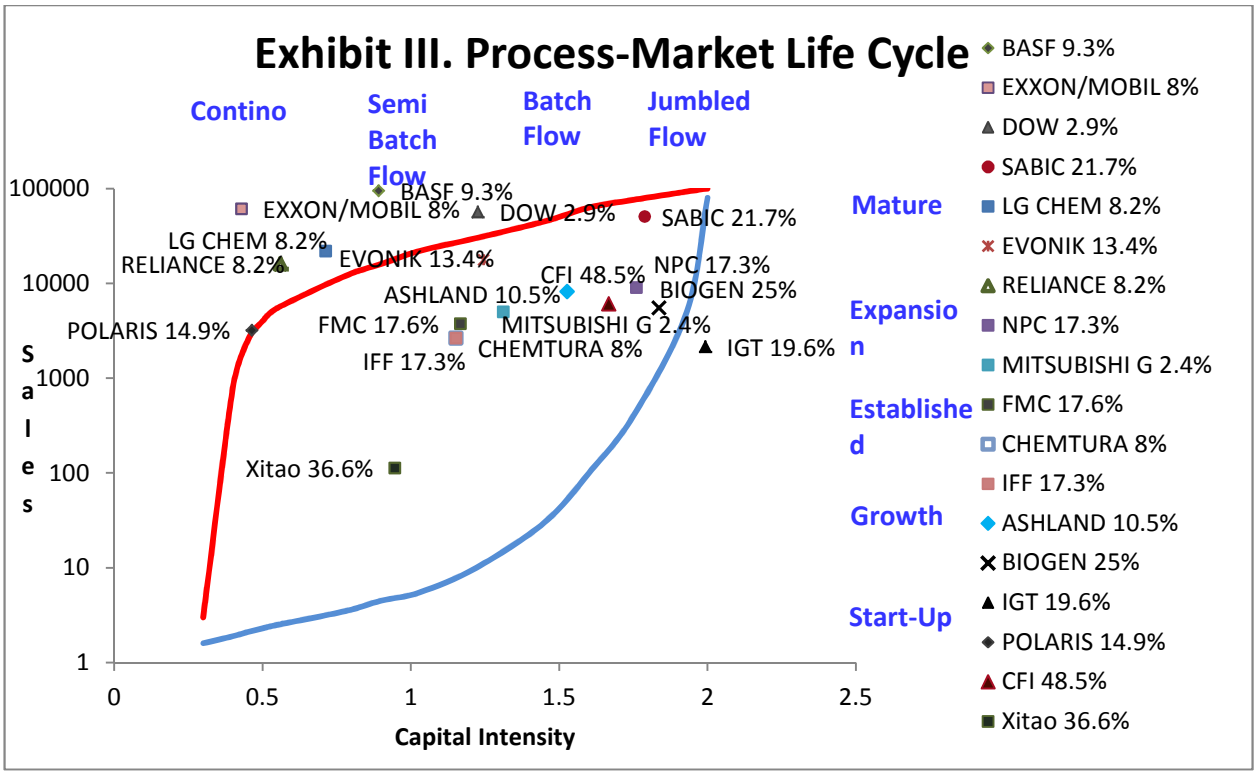

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