The Product-Process Matrix

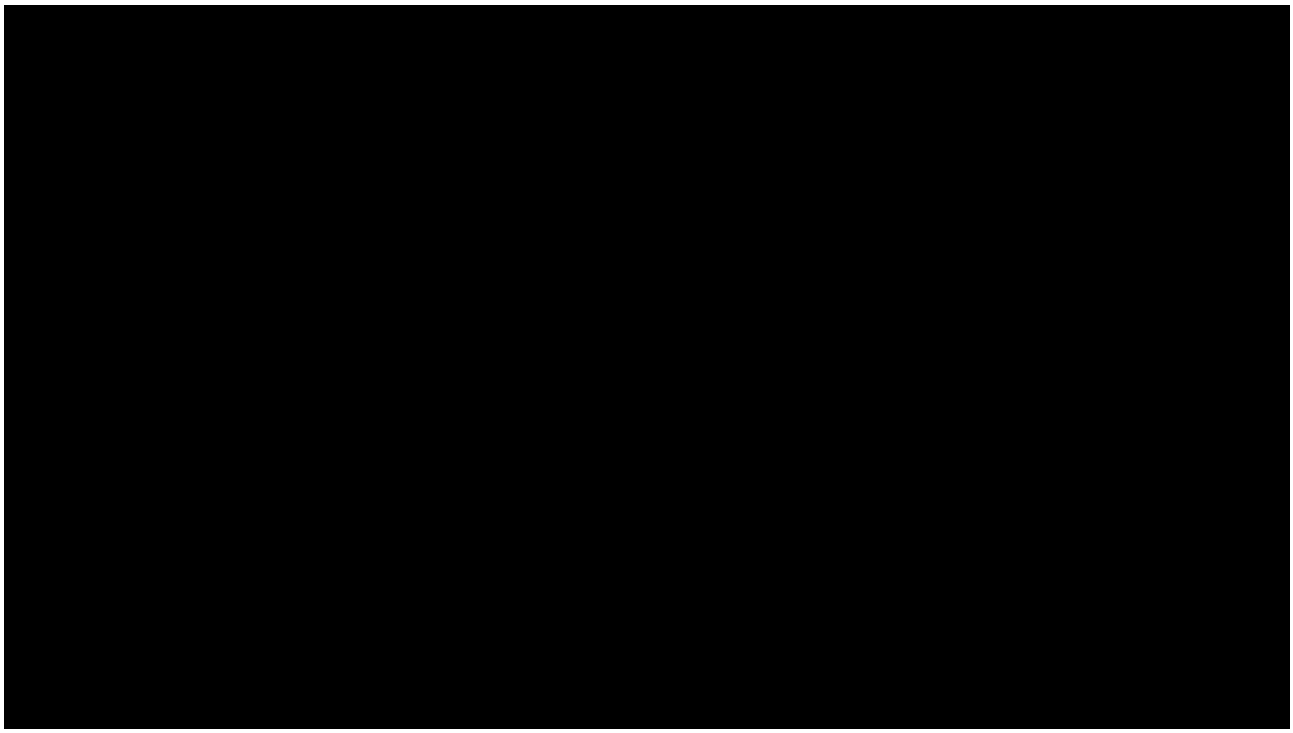
Idea In Short

Match your process structure to your product's life-cycle stage, and revisit that match whenever either one shifts. Staying near the matrix diagonal preserves the fit between manufacturing and marketing; drifting off it, without a deliberate reason, erodes focus and invites competitors to attack. Use the matrix before committing capital to a new process, a new product line or a new market, since it exposes trade-offs that a single-dimension view of strategy misses entirely.

A fast-food outlet runs a short menu through heavily mechanized processes built for speed, selling large volumes at low prices. A gourmet restaurant does the opposite: it builds each dish by hand, customizes it to the diner and sells far fewer meals at a much higher price. Neither approach is wrong. Each restaurant has simply chosen a production process that fits the kind of product it sells, and that fit is exactly what the product-process matrix was built to explain.

The product-process matrix, also known as the Hayes-Wheelwright matrix, is a tool for analyzing the relationship between a product's life-cycle stage and the manufacturing process used to produce it. Robert Hayes and Steven Wheelwright developed it and published it in 1979 across two Harvard Business Review articles, "Link Manufacturing Process and Product Life Cycles" 1 and "The Dynamics of Process-Product Life Cycles". 2 By placing the product life cycle and the process life cycle on two separate axes, the framework gives companies a clearer view of their strategic options, particularly from the standpoint of manufacturing.

Just as a product and its market move through distinct stages of maturity, so does the production process used to make it. Early in a process's life, it tends to be fluid: highly flexible but not especially cost-efficient. As it matures, it becomes more standardized, mechanized and automated, eventually turning into a highly efficient but capital-intensive and inflexible system.



Product-Process Matrix (PPM)

Reading the matrix

The product-process matrix is a four-by-four grid. The rows represent the stages a production process moves through, from a fluid, flexible form at the top to a fully systemic, standardized form at the bottom. The columns represent the product life cycle, moving from highly customized, low-volume products on the left to standardized, high-volume commodity products on the right.

Any company, or a business unit within one, occupies a specific region of this grid, determined jointly by where its product sits in its life cycle and which production process it has chosen to use. In practice, successful positions cluster on or near the diagonal running from the top-left corner to the bottom-right corner.

A commercial 3D printer maker, where every job is essentially unique, typically sits at the top-left. This calls for a jumbled flow or job shop process: general-purpose equipment, such as a robotic arm that could just as easily assemble a different product entirely, and a workforce with broad production skills. These facilities rarely run at full capacity, and any given job spends far more time moving through the plant than the labor hours it actually consumes would suggest.

Move further down the diagonal and you find something like mining equipment, made in a handful of basic models with configurable options, produced through what is called a disconnected line flow. Manufacturing shifts from a pure job shop toward batches of a given model moving irregularly through a series of workstations, sometimes on a low-volume assembly line.

Further down still are products like automobiles or home appliances, offered in only a few models and built on a mechanized, moving assembly line. This process captures real economies of scale through standardization and automation, but the equipment is customized to the specific product, less flexible than earlier stages, and considerably more capital-intensive.

At the bottom-right corner sit heavily commoditized products such as oil or refined sugar, produced through highly automated, continuous flow processes that are standardized, specialized, inflexible and capital-intensive. The rigidity of these processes is more than offset by very low variable costs at the volumes involved.

Why straying from the diagonal is risky

Positions far from the diagonal generally fail to make economic sense, forming what the framework calls dead zones. That said, some companies do find a viable position slightly off the diagonal. Rolls-Royce is a well-known example: it manufactures a limited line of motorcars using a process that looks far more like a job shop than an assembly line, deliberately trading volume for exclusivity and craftsmanship.

Whether straying from the diagonal works depends on how well a company can achieve focus and exploit the advantages of its chosen niche. Done well, it creates a defensible position. Done poorly, it leaves a company vulnerable, because marketing and manufacturing increasingly face different opportunities and pressures, making the two functions harder to coordinate the further apart they drift.

What the matrix helps companies do

The product-process matrix addresses three practical needs: building a distinctive competence, understanding what a given product-process combination actually implies for management, and organizing operating units around distinct manufacturing tasks.

Building a distinctive competence

Most companies want to excel in specific areas while deliberately avoiding competition in others, protecting that strength from outside attack or internal drift. It is easy for management, preoccupied with marketing concerns, to lose sight of manufacturing capability, letting strategy get shaped by product and market considerations alone. That narrows a company's focus to a single column of the matrix and can erode manufacturing competence over time without anyone noticing until it is too late.

Using the matrix forces a genuinely two-dimensional view of strategy, sharpening a company's understanding of exactly where its distinctive competence lies and surfacing process decisions that might otherwise go unexamined.

Understanding what a product-process combination implies

The nature of the management challenge shifts depending on where a company sits on the matrix, since the interaction between product and process structure determines which tasks become critical. A company competing on quality or new product development will choose a noticeably more flexible production setup than a competitor with the same product line pursuing a cost-minimization strategy instead. Choosing a particular process structure also reinforces the corresponding product and market structure that goes with it.

The first approach tends to position a company above the diagonal; the second positions it below or along it. Companies concentrated in the upper-left region eventually have to decide when a product or market has become too costly to serve through a job-shop process. Companies concentrated in the lower-right region face the opposite question: when has a market grown large enough to justify the capital investment a high-volume process demands. The matrix pushes management to think explicitly about product-process fit, which is especially useful when planning a new product.

Organizing operations around the matrix

As products and processes evolve, the matrix helps management align operating units with the specific tasks each one requires. A washing machine manufacturer selling into a fast-moving market through a highly automated assembly line, for instance, may sell spare parts in far smaller volumes that call for a more flexible process. Running both through the same undifferentiated setup makes the operation less efficient for both.

The combination of product and process structure a company chooses also determines which manufacturing problems will matter most, and those priorities shift depending on where a company sits on the matrix. This task-oriented view helps management avoid the loss of control that comes from applying one standard set of controls across every product and process regardless of fit. It is especially useful for large companies producing multiple products across multiple markets, since those products often sit at different life-cycle stages and need manufacturing facilities organized separately to serve each one competitively.

Navigating changing dynamics

External forces can shift a company's position on the matrix relative to competitors even when the company itself has changed nothing. Left unnoticed, that drift can create serious internal problems.

Any move in a product's position without a matching move in the production process, or vice versa, reduces focus and complicates coordination between manufacturing and marketing. A company that automates its process without weighing the marketing consequences, for example, can end up less competitive than rivals who kept their product and process choices tightly aligned. A related trap appears when a company responds to a shift on one dimension by broadening its activity on the other instead of adjusting to match; reacting to a product shift by adding a new process, rather than adapting the existing one, is a common version of this mistake.

Just as marketers segment markets and tailor products, pricing, promotion and sales organization to each segment's needs, manufacturing processes need the same segmented discipline. Resistance to piecemeal expansion tends to be much weaker on the manufacturing side, which is exactly how focus quietly erodes. A low-cost, highly specialized packaging company chasing higher revenue by adding new, less standardized, higher-priced products is one version of this drift. A company built around a standardized product line that diversifies in response to niche competitors is another: its mass-production methods are simply uneconomical at the smaller volumes those niches demand.

In both cases, a coordinated, compensating change across product and process together would have preserved or strengthened the company's competitive position. Broadening only one dimension instead dilutes whatever competence the company had built. The matrix

helps avoid this failure mode and offers a structured way to plan changes to product and process together, keeping management attention on both dimensions at once rather than one at a time.

Using the matrix to plan growth

Because growth inevitably raises both product and process questions, the matrix is a natural framework for guiding growth strategy. Companies generally pursue growth in one of four ways: simple growth of volume within an existing product line and market, expansion of the product line within an existing market using the current process, expansion of the process structure itself, or expansion into entirely new products and markets.

Type 1: Simple growth

Simple growth means increasing volume using an existing product line and existing process, which requires unusually stable conditions in competition, technology and market taste, with the only real variable being market size. Such stability is rare, so even a company that keeps its product and process activities narrow will eventually need to make changes as markets and technologies mature.

Pursuing simple growth requires two decisions: when to enter or exit a given market, and which product and process strategy fits the market's realities. Companies broadly choose among four entrance-exit strategies: entering early and exiting once the technology stabilizes, margins compress and larger competitors arrive, using superior flexibility to pivot elsewhere; entering early and growing alongside the industry to become a major, long-term player; waiting on the sidelines until the market and process have stabilized enough to justify entering with the scale a large company can bring; or a delayed version of that same waiting strategy, entered too late to establish a sustainable position, forcing withdrawal without an adequate return.

Once an entrance-exit strategy is chosen, management still has to select a product and process development path, and those choices can be mapped as routes across the matrix. An industry as a whole tends to move down the diagonal over time, and companies typically make one kind of change at a time, either to the product or to the process, rather than both simultaneously. The pace and scale of that movement is driven more by product maturation and technological change than by any single company's decisions, but a company can still

choose to lean above or below the diagonal, or hew as closely to it as possible.

Sitting above the diagonal buys flexibility: the ability to change products, volumes and processes quickly, with lower capital requirements, at the cost of vulnerability to competitors who can undercut on price, delivery or specification. Sitting below the diagonal buys a real edge in price and delivery, but locks a company into a fixed set of facilities and capabilities that make it harder to respond as the product life cycle moves on. The matrix helps a company track its position relative to competitors and flags when it has drifted too far in either direction, becoming distinct enough from rivals to invite an attack, while also keeping marketing and manufacturing coordinated around a shared set of priorities.

Type 2: Product growth

Product growth broadens the product line in one of two ways: adding more standardized products while keeping less standardized ones, or adding special features to an already standardized line. The first represents a shift left on the matrix and typically happens because marketing believes a full product line is necessary for good service, while manufacturing sees new products as a way to absorb overhead and fixed costs. The second also shifts the matrix leftward and runs against the general current of the product life cycle, which otherwise pushes toward continued standardization. Both put real strain on production processes not originally designed for the added variety, which is exactly where aligning operating units to the evolving matrix position becomes important.

Type 3: Expansion of the process structure

Process expansion mirrors product growth but happens on the other axis: a company keeps its existing process while adding either less standardized, more flexible capacity through forward integration, or more standardized, less flexible capacity through backward integration. Vertical integration of this kind is rarely simple, since it can mean producing an entirely different product that sits at a very different point on the matrix, effectively requiring its own separate matrix and its own distinct strategy. Without that separate analysis, a company risks producing the new component using a process and organizational structure that was never designed for it.

Type 4: New markets

Entering a new market or launching an entirely new product is the most demanding growth

path, since it forces change on both dimensions simultaneously. Expanding the product line pulls a company back horizontally on the matrix even as it tries to serve a market its existing processes were never built for. Marketing has to adapt to unfamiliar customer needs while production strains to accommodate products it wasn't designed to make. The matrix helps managers position deliberately along both dimensions, so that marketing and manufacturing each carry a focused, well-defined set of responsibilities rather than drifting too far from the diagonal in the process.

Why the matrix still matters

The product-process matrix helps a company diagnose how its strategy has evolved, think through its future options and get marketing and manufacturing coordinating explicitly around shared competitive goals, rather than pursuing separate agendas that happen to intersect. Companies can lose their way without noticing, and the matrix offers a concrete way back: determining the right mix of manufacturing facilities and the critical objectives for each one, reviewing whether capital investment decisions actually match product and process plans, deciding the timing and direction of major process changes, weighing product and market opportunities against real manufacturing capability, and choosing the right process and product structure before entering a new market. Nearly five decades after Hayes and Wheelwright introduced it, the matrix remains one of the clearest tools available for keeping strategic ambition and operational reality pointed in the same direction.

- 1Link Manufacturing Process and Product Life Cycles
- 2The Dynamics of Process-Product Life Cycles

Summary

The product-process matrix shows that manufacturing choices and product choices must move together. Firms that let one drift without the other lose the coordination that made their strategy work in the first place.