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by Alex Kandybin, Martin Kihn, and Cesare R. Mainardi

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Reinventing Scale

How to Escape the Size Trap

by Alex Kandybin, Martin Kihn, and Cesare R. Mainardi

For decades, packaged seafood production was considered to be a quintessential scale business (pardon the pun). The seafood industry believed itself to be engaged in can making and canning, capital-intensive activities that require large up-front investments in manufacturing and production operations. Because they were overseeing plants with high fixed costs, owners naturally wanted to spread this burden over as many cans of fish as possible. In the language of microeconomics, they saw packaged seafood as a business with obvious economies of scale, where unit costs fell as production volumes increased.

The quest for scale required seafood producers to balance the total delivered cost of fish with efficiency in can making and canning — the act of stuffing meat into cans. Because some 60 percent of the fish (heads, tails, bones) doesn't end up in the can at all, it makes no sense to incur costs to transport it to distant factories. This logic suggested that canning plants should be located in the middle of the fishing grounds, generally in less-developed countries and islands. However, canning and can making require relatively developed infrastructures and access to skilled labor. Ultimately, to balance the total delivered cost of raw (the industry term is "round") fish with efficiency in canning and can making, most U.S. tuna suppliers settled on three major production locations (Thailand, American Samoa, and Puerto Rico), where they built large, fully integrated plants that processed round fish into finished, canned product.

Generation by generation, though, margins in the seafood production industry declined. The profit pressure forced major seafood packers to explore creative

Illustration by Bob Goldstrom

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ways to reduce costs. To find savings opportunities, they declared everything within their operations fair game for reevaluation.

In exploring one firm's extended value chain to see exactly where costs were spawned and how they might be dampened, we concluded that the problem clearly lay in how producers approached the logic of scale. Conventional wisdom held that when scale applied, it applied *everywhere*. But, although stamping out cans from sheets of rolled metal and filling them with seafood may fall neatly within anyone's definition of a scale business, the value chain steps prior to canning are not so amenable. In fact, the activity of cleaning and preparing a fish (called loining) is painstaking, performed by hand for every fish, every time. It cannot be mechanized effectively, though many have tried to do so. Thus, there is no significant cost advantage — no real "returns to scale" — in increased production volumes.

Indeed, the mapping of the value chain made clear what had been implicit all along: The seafood packaging process was more usefully viewed as two separate and very different processes, labor-intensive *loining* and capital-intensive *canning*. The latter process could benefit from economies of scale; the former could not.

Conceptually splitting the processes apart had powerful implications for the firm's global operations. It turns out that loining and canning didn't have to be colocated. As a low-skilled activity requiring minimal infrastructure and operational support, loining could occur in regions unable to support a manufacturing operation, such as low-wage countries (often islands) in the middle of the fishing grounds. The processed loins could then be frozen and shipped to consolidated, large-scale canning and can-making operations. These operations would be located in more developed areas with the necessary skilled labor and supply and support networks. A network of loining operations spread across different fishing grounds offered an additional benefit. Because the price of fish tends to fluctuate widely by geography, a loining network with multiple locations allowed the company to reduce costs by shifting production to those places where the price of fish was lowest. Since the fish content represents almost half of the cost of the finished product, this flexibility was a significant bonus.

In the end, the seafood packager was able to save on bulk shipping costs by doing its labor-intensive loining "on-site," in the middle of the fishing grounds. The 60 percent of the fish that didn't end up in the can wasn't shipped anywhere. Meanwhile, by consolidating canning and can making in a few centralized facilities, the company ultimately realized better economies of scale where they actually applied.

Today, all leading tuna manufacturers follow a similar operations strategy. Bumble Bee ships frozen loins to its canning facility in California; Star-Kist has increased the canning and can-making capacity of its plant in American Samoa and has converted part of the operation to process frozen loins. We estimate the tuna industry has saved more than $100 million since adopting this new structure and has substantially improved return on invested capital and return on assets as a direct result of optimizing loining and canning operations.

This — you'll excuse the expression — sea change in the fortunes of a mature industry, seemingly burdened by fixed costs and inflexible operations, was made possible only by the reconception of a commonplace idea: economies of scale. For too long, a black-and-white

myopia has applied scale either everywhere or nowhere in manufacturing industries. We would argue for a more nuanced view — a fundamental *reinvention* of scale. This reinvention can be accomplished in most industries by breaking the operation's value chain into vertical functions and horizontal product flows, examining the real cost drivers, and finding those parts of the business where scale applies and those where it does not. By applying the concept of scale differently across different parts of a business, a firm can unleash real power and unlock hidden value.

Why Size Matters

Few tenets of economic thought are as timeworn as the concept of economies of scale — that is, the more units you produce, the lower the cost for each individual unit. So hoary is this concept that all too often it goes unscrutinized. There are certainly industries, products, and geographies where nobody thinks being really big can help much: prescription eyeglasses, Formula 1 cars, or fine art, for instance. However, by and large, manufacturing companies believe that scale can lower their cost of goods and raise margins.

The concept of scale originated during the Industrial Revolution, when the manufacturing sphere changed rapidly from a customized universe of artisans and craftsmen producing piecework goods into factories staffed by dozens of workers taking steps toward mass production. In the custom-made clothing business, there is no scale; every tailored shirt is as expensive to make as the one before, and making a lot more shirts does not lower the cost of any one of them. But move that business into a factory outfitted with broadlooms and taking mass delivery of raw materials, and you start to realize the benefits of scale. Producing more units almost always brings the cost of each individual unit down, as the fixed costs of the looms and other overhead are spread over more and more shirts.

The early literature in what was then called "political economy" was rife with excitement over the power of this emerging concept. Adam Smith opened The Wealth of Nations with a paean to "this great increase in the quantity of work which, in consequence of the division of labor, the same number of people are capable of performing…." As business historian Alfred D. Chandler Jr. points out in his classic Scale and Scope: The Dynamics of Industrial Capitalism: "The major innovations made in the processes of production during the last quarter of the nineteenth century created many new industries and transformed many old industries. These processes differed from earlier ones in their potential for exploiting the unprecedented cost advantages of the economies of scale…."

As the concept of scale evolved, increasing attention was paid to the trade-offs — for example, scale versus distribution. Having scale entails large centralized plants, but companies still have to get the goods to the customers, who may be scattered far and wide. Trade-offs also arise in warehousing and inventory costs. Economic Order Quantity (EOQ) — a formula developed in the 1930s to guide managers in setting order sizes by estimating such variables as inventory holding cost, cycle time, and demand — was one attempt to quantify this problem. Today, elaborate linear and integer programming software is available to "optimize" all trade-offs.

Unfortunately, sophisticated tools rarely guarantee sound thinking. For example, many dot-com ventures requiring large capital investments were defended with the concept of scale. The online grocer Webvan Group Inc. signed a contract with Bechtel Group Inc. to develop 26 automated "picking and packing" warehouses for $30 million each. These warehouses were justified on the grounds that their huge scale and high throughput would give the firm a cost advantage. In fact, if the volume had ever materialized, the concept might have been solid. Webvan erred fatally, however, in assuming that economies of scale in one area (picking and packing) applied to its *entire* business. They did not. In the "last mile" — the final step in getting the goods to the customer — there are few economies of scale. Indeed, there may well be *diseconomies* of scale in the last mile. Venturing beyond certain very dense pockets of population (such as Manhattan's Upper West Side), each incre-

mental customer might *increase* the overall cost to serve; this sad fact, in turn, could prevent the provider from ever reaching the size necessary to capture the benefits of scale in its large centralized operations. (See "The Last Mile to Nowhere: Flaws & Fallacies in Internet Home-Delivery Schemes," by Tim Laseter et al., *s+b*, Third Quarter 2000.) Webvan, Kozmo.com, and other online delivery companies failed in part by overapplying the concept of scale.

That failure was based on what we call "binary" thinking about scale: In industries where scale is believed to apply, it is generally thought to apply always and everywhere. We saw this phenomenon at work in the seafood industry, where the concept of scale was applied to the entire manufacturing process, with no distinctions made among loining, canning, and can making. On the other hand, where scale does not seem to apply — when there appears to be no advantage to size and concentration — its usefulness is too often summarily rejected. Witness the case of the battery maker that assumed because batteries are heavy (and thus expensive to distribute), scale could not apply to its business. Following that logic, the company built plants all over the country to be close to its customers, meanwhile losing out on virtually *all* the benefits of scale.

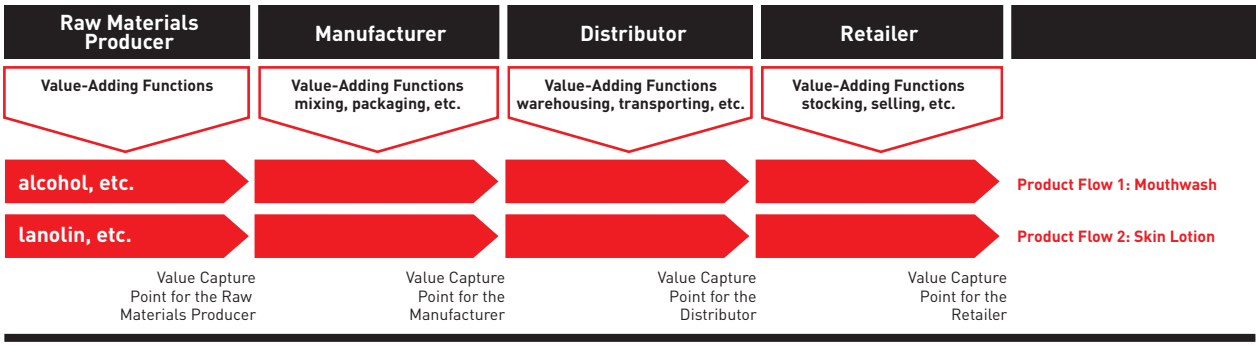
Reimagining Manufacturing

Recent work with a number of manufacturing clients has led us to question this binary perspective and develop a new way of looking at scale that is both intuitive and, in its way, a bit radical. We have come to believe, in manufacturing as in so many other affairs, that size may not matter. By breaking the value chain into its component parts, a company can adjust its operations to match the underlying scale economics of the specific process, like a seasoned angler custom-weighting the individual

Exhibit 1: **Escaping the Scale Trap – The Three U Framework**

Understand	Unbundle	Unleash
Map existing value chain • product flows • value-adding functions Segment product flows • complexity • demand profile • service requirements • process technology Segment value-adding functions • labor intensity • scale • energy consumption	Unbundle value chain into individual components based on cost drivers Leverage true economies of scale and scope at the level of unbundled elements Look across channels and beyond company boundaries Seek alternative economic trade-offs Explore nontraditional structural combinations	Determine new constraints and trade-offs for each structural option Maximize value across entire chain • Take advantage of scale economies • Optimize cost-to-serve/value creation trade-off Select best option Implement

Exhibit 2: **Value Chain Matrix – A Consumer Health-Care Company**



segments of his rod.

This reinvention of scale has clear implications for manufacturing industries. Manufacturing is a competitive, aging universe; decades of evolution have driven fat from many processes, while industry players seek continuous operational improvement. Each decade or so yields new techniques. Henry Ford found his panacea in vertical integration; in the 1980s, Ford Motor Company embraced W. Edwards Deming's quality crusade. The 1990s saw a new version of Demingism (Six Sigma), as well as strategic sourcing and supply chain management.

What's next? Our experience in industries ranging from aerospace to packaged goods, from pet foods to petrochemicals, leads us to believe the next step in the evolution of manufacturing will be some form of reinventing scale. As manufacturing organizations have decentralized all but core capabilities — while at the same time entering into dependent relationships with key strategic suppliers and partners — they have become *more* complex, not less. They resemble many-segmented organisms, to which no single, all-encasing concept is appropriate. Reinventing scale through value chain mapping and a deeper understanding of costs is a step toward adapting this important economic concept to new manufacturing realities. By escaping the binary thinking that has entrapped them, companies can unleash value, perhaps from places they didn't know, or even suspect, contained it. Equally important, they can avoid paying to mine value from areas inaccurately assumed to hold it.

What does it mean to "revisit scale" and "unleash value"? The fundamental issue, obviously, is cost. After all, economies of scale are *defined* as cost savings due to volume. Therefore, only by understanding the real costs inherent in the flow of products and in the manufacturing processes themselves can we discover untapped value.

Most manufacturers continue to see themselves, mistakenly, as somewhat unitary, static businesses. But a large business is really a network of intertwined, small, value-adding functions and product flows, each of which may be subject to very different scale effects. Some steps in the value chain (e.g., canning) may indeed require a traditional bigger-is-better type of operation, while others (e.g., loining) definitely do not.

This core understanding underlies what we term the "Three U Framework" for reinventing scale. (See Exhibit 1.) The three elements of this schema, which are detailed below, are:

1. **Understand** — map your value chain.
2. **Unbundle** — break it apart.
3. **Unleash** — put it back together in a different way, taking advantage of any real economies of scale.

Step 1: Understand and Map

The value chain should be thought of as extending from raw materials to final sale, consisting horizontally of multiple product flows and vertically of the value-adding functions, such as transportation, conversion, and selling. (See Exhibit 2.) Companies have become quite adept at parsing their value chains, but not — in our experience — in the context of looking for scale.

The horizontal dimension shows the flows of different products (from raw materials to finished goods) that are going through a series of actions (e.g., manufacturing, distribution, and, finally, sale) that increase their value, step by step. The company might do business in all, some, or just one of these categories, but it is important to understand all of them, building what is known as an "extended value chain."

The reason for mapping an extended chain is that you might discover opportunities to collaborate, outsource, merge, acquire, or otherwise involve other firms in your operation to your advantage. Product flows are mapped by design, functionality, complexity, demand

By applying the concept of scale differently across different parts of a business, a firm can unleash real power and unlock hidden value.

profile, service requirements, process technology, and other criteria relevant to the industry. For example, an aircraft landing-light manufacturer mapped its product flows prior to reinventing its own concept of scale. Years of treating each order as "a brand-new day" had saddled the company with prohibitive costs. By carefully charting its product flows, the company was able to locate areas in the production process that were duplicated across a large number of products — areas where achieving scale could drive down costs.

The vertical dimension describes the functional areas of the business (e.g., making a product, selling a product, R&D). In contrast to the horizontal flows, vertical operational flows are mapped by a separate set of performance criteria: labor intensity, scale, energy consumption, and others relevant to the industry.

Step 2: Unbundle and Determine Cost Drivers

Now that you have a useful map of the value chain, it's time to *unbundle*. Unbundling entails breaking the value chain down and examining it step by step, looking for exactly where the costs are and what drives them. The ultimate goal is a step-by-step understanding of cost economics and return on assets, to determine where capital is tied up and where costs arise.

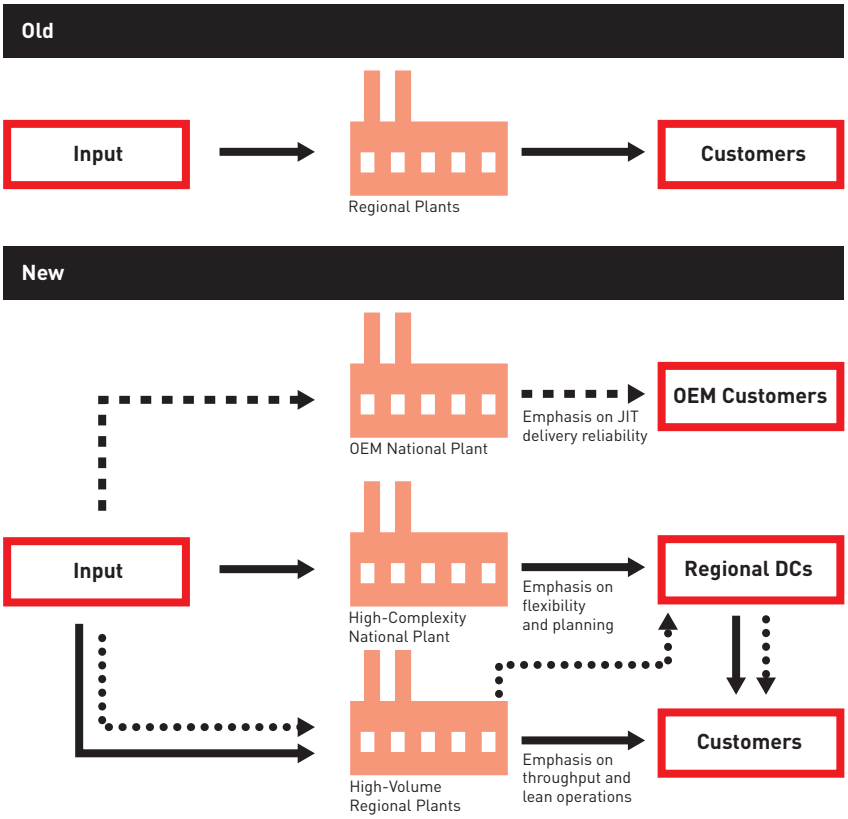
Optimizing value across an extended value chain requires understanding the economic profitability of each step along both the horizontal (product flow) and vertical (function) dimensions. Here we are talking about actual economic profitability, not just its accounting treatment. For example, the cost of making a can includes not only direct materials and labor, but also management time, energy, actual wear and tear on machinery (not just depreciation), and opportunity cost (that is, the return on the best alternative use of the capital tied up in the can), among others.

Start with the vertical dimension — the value-adding functions — because these are somewhat more intuitive and traditional for cost analysis. Again, the topic is the *real* drivers of cost. A useful tool for describing cost drivers is Booz Allen Hamilton's ISSR framework, named for the four types of costs it describes: Inherent (process technology, product design), Structural (vertical integration, distribution network, complexity, labor and transportation rates, local raw materials costs, duties), Systemic (operating policies/principles, process-/product-oriented floor layout, resources and capacity management, organization infrastructure, information technology), and Realized (efficiency, productivity, utilization).

Try to unbundle the value-adding functions, exploring all individual processes and operations within manufacturing, distribution, selling, etc., at the lowest level possible to determine what each step actually costs. For instance, in our seafood example, we examined the cost of loining down to the level of the individual loining table, determining how many workers could fit safely around a single table in different locations, and how many loining implements were worn out per worker each year.

After charting value-adding functions, move on to the horizontal dimension — product flows. In unbundling individual product flows, look for the cost drivers that could be product-specific, such as process technology, design, complexity, and duties. The aircraft landing-light company ultimately was able to use a product flow map to segment its manufacturing process into three lines: a high-speed line to capture scale, a

Exhibit 3: **Power Trip – "Unbundling" Value in Industrial Batteries**



smaller line for products with some similar components, and a low-volume "job shop" for one-off orders. Vertical and horizontal unbundling is often a circular process that has to be repeated until the emergence of a two-dimensional matrix with clearly identified cost drivers in each cell.

Consider the mapping and unbundling analyses we did for one client, a manufacturer of automotive batteries. Its products fall into three main types: batteries for original equipment manufacturers (OEMs); for specialized non-OEMs, which require relatively complex manufacturing processes; and for standard non-OEMs, which require less complex processes. Because large batteries are relatively heavy, their production must necessarily be localized within the region of sale, or so it was thought. It was assumed that any scale benefits that resulted from centralizing operations in a single location — or even a few locations — would be negated by high distribution costs to truck the batteries to their final destination. The result was a manufacturing footprint characterized by regional plants producing products for regional customers. Moreover, all plants produced batteries of all three types, leading to a relatively high "cost of complexity" due to multiple production lines, frequent changeovers, and intensive production planning.

In the course of unbundling the value chain into horizontal product flows and identifying detailed cost drivers for each flow, the company discovered that its complexity costs for some products exceeded its distribution costs. In other words, the company ended up spending more to maintain its decentralized footprint than it did to distribute its batteries. By segmenting the product base along the lines mentioned above, the company found it could realize considerable value by using a "partially scaled" process.

The segment of the business consisting of large OEM customers demanded high levels of service and follow-up; in this segment, manufacturing could most profitably be consolidated into one national plant, which would emphasize just-in-time delivery and reliability. Significant scale economies could be realized simply by making more products in one place. Likewise, the segment consisting of complex manufacturing operations could also be combined into a single national plant, with an emphasis on flexibility and planning. Additional scale economies could be realized through this consolidation.

Finally, the remaining plants were standardized and rationalized into fewer high-volume regional plants serving the aftermarket. Because manufacturing processes for these customers are more routinized, these "run, run, run" plants could emphasize throughput and lean operations. (See Exhibit 3.) Realigning plant functions required a base-level optimization of the distribution

network and required adding a new warehouse. In addition, new inventory levels had to be modified throughout the entire value chain. The result was a 28 percent reduction in conversion costs, growing market share, and a significant increase in profits.

Step 3: Unleash Value by Reoptimizing the Value Chain

Now that we *understand* our product flows and our value-adding functions, and now that we have *unbundled* the steps to reexamine their cost drivers and capital intensity, we can *unleash* value and operational efficiencies. How?

An important part of unleashing value is to determine ownership. Options for vertical integration should be carefully developed. In the examination of these options, it is important to assess their financial and strategic implications. It may prove profitable to reposition the company in the value chain through outsourcing, divestiture, acquisitions, partnerships, or alliances. At a fundamental level, power and value are unleashed by reassembling the value chain in a different way, thereby taking full advantage of potential scale economies.

Some years ago, we worked with a major airline client, exploring ways to streamline the often cumbersome and costly process of maintaining its passenger jet fleet. For several years, many airlines had been evaluating whether to maintain their own engines or to outsource the task. At first glance, it might have appeared that engines are so critical to keeping a fleet in the air that an airline would need to control its own maintenance or risk losing control of a fundamental asset. It turned out, however, that engines could be inventoried like many other spare parts, and that externally maintained whole working units could be brought into service more easily than individual components. Consequently, airlines can shed significant assets associated with maintaining large numbers of engines for different types of aircraft, as well as the bookkeeping, cataloging, warehousing, and other administrative functions associated with maintenance.

The significance of this question — whether or not to outsource engine maintenance — may seem unrelated to scale, but in fact it is fundamentally interconnected, tied to the vertical, functional flows of the value chain. Until quite recently, many airlines believed they benefited from a large central "repair hangar," where they could achieve scale in storing spare parts, managing maintenance, and staffing mechanics. However, by unbundling the vertical functional value chain (labor and materials involved in maintenance) and the various product flows (engines, avionics, landing gears, etc.), the airlines saw that greater scale efficiencies could be realized by the engine manufacturers — and that outsourcing maintenance to the manufacturers was a way to unleash this value. The manufacturers could realize greater scale economies by providing full engine service and parts for airlines across the world by dedicating maintenance–flow lines to each engine type. And the airlines no longer had to labor under the incremental burdens of buying and warehousing large quantities of parts, and training and paying mechanics.

Outsourcing what was thought to be a critical "scale" capability proved to be a profitable idea for another of our clients — a major pet-food company. For years, this firm had assumed that owning its own large centralized manufacturing plant in the middle of the grain belt was an important way to realize economies. After all, its executives reasoned, grain is the major component of many dry pet foods, and a huge plant near the source of this input cuts down on transportation costs, while realizing scale benefits in large centralized plants.

By unbundling the vertical process flows, however, our client came to see that there was an offsetting factor — high distribution costs for the packaged finished product — that substantially undermined, and even reversed, the scale benefits. The real economics of the process proved that shipping pet-food boxes across the country cost more than was saved by centralized production. The solution was outsourcing production to regional copackers, thus creating a national footprint of plants closer to the customer base. These regional copackers already had large plants that served many other manufacturers and retailers. This allowed our pet-food client to capture substantial distribution and lead-time benefits while not giving up any economies of scale.

It is important to note that we do not propose outsourcing as the single tool in the box. Reinventing scale means recapturing value that is hidden within the value chain because of fundamental misconceptions about scale. Once it is identified, such value can be recaptured by a restructuring of the value chain, or through a change of ownership, such as an acquisition, divestiture, or outsourcing. Although outsourcing worked well in the pet-food example, it did not apply to the seafood packer or the battery manufacturer.

Escaping the scale trap has potential applications

One pet-food manufacturer assumed a giant plant in the grain belt would realize economies. In fact, it cost more to ship boxes from the plant than was saved by centralization.

not only in manufacturing, but also in retailing, and more widely in service industries. Although service businesses don't manufacture products, they certainly have internal processes and value chains that can be subjected to fruitful analysis. Scale might be enjoyed in numerous localized instances, such as back-office operations. Each step in a service value chain has cost drivers, and wherever larger volume drives costs lower, scale economies can emerge.

A New Approach to Operations Strategy

Economies of scale are the blessing and the curse of manufacturing life. We have seen how it simply makes no sense to apply this basic idea indiscriminately across any organization. If a value chain is a series of steps from raw materials to final sale, then each value-adding step of that chain can be thought of as a mini-manufacturing process all its own — with inherent real costs, and a real market value for the product. Looked at this way, the manufacturing process is not a holistic either/or proposition with respect to scale, but rather a series of incremental opportunities to appropriately exploit real rather than perceived scale economies. Capturing all these incremental opportunities leads to significant change.

We believe our concept of understanding, unbundling, and unleashing to be a new approach to developing operations strategies. Traditional strategy focuses on developing a single deterministic solution, rather than optimizing a flexible web of partners (supply chains) facing demand and supply uncertainties. It optimizes operations functions within traditional vertical trade-offs (e.g., manufacturing scale versus distribution costs), versus finding nonobvious trade-offs based on horizontal product flows. It focuses on product costs, rather than a deep understanding of cost drivers and value creation. And, finally, it typically optimizes one measure (labor, or inventory, or costs, etc.), rather than maximizing value capture across an extended enterprise.

The opportunity to *understand*, *unbundle*, and *unleash* has never been greater, given unprecedented pressure on most companies' supply chains. Globalization and increased product complexity have escalated competition. Capacity has increased, due mainly to productivity's improving at a faster rate than market growth. At the same time, flexibility is more in demand, and asset effectiveness is declining as manufacturing's relative share of added value continues its own decline — now, less than 10 percent of profit contribution utilizes up to 50 percent of asset investments. It is within this environment of rapid supply chain rationalization that fundamental concepts such as scale must be revisited. ✚

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