



EXPERTISE

ON

DEMAND

The supply chain world needs industrial engineers now

BY JAMES B. AYERS

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An article by Louis Martin-Vega published in the December 2008 issue of *Industrial Engineer* listed four challenges and opportunities for the industrial engineering profession. These matched concerns driving the recent IIE name change initiative. Martin-Vega's list is summarized as:

- Globalization: The “flattening” world drives the need for supply chain and process change.
- Industrial: The discipline's descriptor is too limiting given the multiplicity of IE application areas.
- Societal changes: Many change types (environmental, security and advanced technology) challenge currently defined boundaries for the profession.
- Expectations: Aspiring IE graduates are denied promised “cognitive” (decision making, collaboration, self-direction) responsibilities upon reaching the workplace.

The list is certainly a credible articulation of the challenges and opportunities facing the IE profession. To some degree these challenges have been with us since the early 1970s. This article offers a view on the evolution of our IE profession and the market's needs for IE services, particularly in the area of supply chain management.

Evolution of a profession

When I attended the master's industrial engineering program at Stanford, the graduate options included economic systems planning (mostly financial justification techniques), operations research, production management and systems tracks. The department later expanded its name to Department of Industrial Engineering and Engineering Management. The change responded to employer requests for engineers who understand management. In 1999, the department joined several other small departments to become the Department of Management Science and Engineering (MS&E). Core areas of research pursued by the current department include decision analysis and risk analysis; economics and finance; information science and technology; optimization and tools of system analysis; organizations, technology and entrepreneurship; probability and stochastic systems; production and operations management; and strategy and policy. Note the topics overlap many topics covered in business schools.

After its formation, the MS&E department offered alums a diploma from the new department. I didn't accept the offer, having found the “industrial engineer” label to be a marketing

asset, and survival in consulting depends on marketing. Both “industrial” and “engineer” signal that the analysis and recommendations will be rigorous. And as a practicing IE, my experience is based in the manufacturing industry — a sector open to intense international competition. The designation has also helped service other big technical professionals including chemical, civil, mechanical and electrical engineers.

Lessons from consulting

Changes in client needs in recent years also echo the challenges and opportunities on Martin-Vega's list. In the late 1990s, industry started framing its operations in a supply chain context, moving away from viewing operations as several isolated functions inside the company. The terms *supply chain* and *supply chain management* (SCM) have different meanings from practitioner to practitioner and company to company. However, most accept that it places end-users at the end of a chain of linked enterprises that extends back to raw material sources. The formation of the Supply-Chain Council in 1996 was emblematic of this trend. The 2005 name change of the Council of Logistics Management (CLM) to the Council of Supply Chain Professionals (CSCMP) also reflects the shift. New SCM courses at universities, including Stanford, hold promise that the discipline will be permanent.

Prior to SCM's emergence, consultants had specialized in the traditional supply chain links like manufacturing, purchasing, distribution and inventory management. Our rebranding from logistics and manufacturing consultants to supply chain consultants was an easy transition. Many of our current projects remain functional, but clients demand the broader perspective that goes with the supply chain banner.

As consultants, we practice the “art of the possible” and are measured by the impact we have on our clients' businesses. Our biggest challenge is to convince managers — who are not IEs or not often very technical — to make changes. To be motivated they must be convinced the changes are good for their business. This is where the “art” comes in, calling on difficult-to-teach soft skills.

Figure 1 lists frequently encountered barriers to change. The barriers take the form of client mindsets, or paradigms. If we are to be effective, we must shift existing client paradigms — generally from the “conventional” to the “emerging” paradigm shown in the table. Paradigm shifting skills fall into the “cognitive” category that employers, according to Martin-Vega, may not see in today's IE graduates. It's not

hard to imagine that these skills will be in increasing demand. In challenging times, companies must rely on execution in operations to implement their strategies successfully.

The next section describes the four paradigm shifts in more detail. In planning an improvement project the process engineer must look for the presence of conventional mindsets that might impede needed changes. This assessment can be formal and structured or informal and unstructured. Where the mindsets may jeopardize the mission, work must be done to shift that mindset.

Straight from the board room

The first paradigm category, how executives view markets, reflects views of the *territory* in which the company operates and the variables the company can influence. Often this territory is overly local when much can be gained by thinking more globally. The area of influence also defines opportunities to

put IE skills to the test. We define territory more formally as the customer and end-user markets, channels to those markets, products and their design and the operations that support the business. Operations extend beyond factories to upstream and downstream supply chain trading partners. Within the company everything is included — production, administrative, financial and technical functions.

Another mindset is that the best supply chain is the cheapest supply chain. This precludes following the lead of marketing practitioners who “segment” or group their products and markets. Segmentation leads to focused strategies and multiple supply chains. Companies should define “spheres” or “businesses inside the business.” The term, *sphere*, derives from our taxonomy for defining them in three dimensions — markets, products and operations.

For example, Wal-Mart Stores Inc. has created separate processes and facilities for handling staples that consumers buy

SHIFTING PARADIGM

CONVENTIONAL PARADIGMS	EMERGING PARADIGMS
<p>How executives view markets</p> <ul style="list-style-type: none"> Thinks local One-size-fits-all works 	<ul style="list-style-type: none"> Thinks global Focused chains are better
<p>How executives frame organization</p> <ul style="list-style-type: none"> Mindset is organization-centric Improve existing processes 	<ul style="list-style-type: none"> Mindset is process-centric Invent new processes
<p>How executives view operations improvement</p> <ul style="list-style-type: none"> IEs are “industrial” and limited Charter is inside four walls Optimize steps Maximize production Strives to be lean 	<ul style="list-style-type: none"> IE skills are needed throughout Charter is supply chain Optimize supply chain Match supply and demand Strives to be flexible
<p>How executives measure effectiveness</p> <ul style="list-style-type: none"> Cost reduction marks progress Technology is sufficient Project management discipline is lacking Vertical accounting is legal and best Forecast-driven replenishment is unavoidable 	<ul style="list-style-type: none"> GMROI can be the better metric Organizational complements matter as much Formal project management processes followed Horizontal accounting is best for decisions Demand-driven replenishment is the goal

Figure 1. Paradigms that have evolved into supply chain management essentials

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on each trip to the store. When such items are lost in the “last 90 feet” from the dock to the store shelf, the empty shelves irritate customers. These items aren’t necessarily particularly profitable, but their too-frequent absence causes customers to go where they complete their buying in a single stop.

In another example, Nike Inc. shifted its business unit focus to preserve the profits on its high-margin sports products. Previously organized around product categories (e.g., shoes and apparel), they shifted to sport-focused business (e.g., tennis, basketball, golf) with products designed to meet each sport’s unique demands. These finely tuned products sustain higher margins.

The second paradigm category, how executives frame organizations, contains mindsets that limit how broad a charter the IE might be granted. An organization-centric mindset places the responsibility for change on functions or departments. This yields an improvement project portfolio of local projects and will not achieve an enterprise or supply chain impact. An example is the IE reporting to the vice president of manufacturing assigned to the shop floor. That IE’s mission will be limited to department boundaries. The projects will center on tuning existing processes.

The emerging paradigm broadens the charter. That charter includes processes that cross department boundaries. This calls for the soft skills needed to juggle the concerns of multiple department heads. Creative juices are also called for. New processes designed to support strategy can improve both top-line and bottom-line results. The Wal-Mart and Nike examples are strategies that require IE support, and this coincides with another paradigm category, how executives view operations improvement.

This paradigm category addresses the way executives perceive IE work. It is related to organization framing but is still different. An executive could be process-centric and willing to invent new processes. But turning to the IE may be counterintuitive. This also appears to be a barrier the name change will address. A longtime client, a senior vice president and general manager at Bell Helicopter, was a manufacturing engineer ensconced in the traditional ME-IE culture. It was hard to escape lunches with the gentleman without his designing the next generation machine tool on a napkin. It must have been a leap of faith when he chartered our firm to apply IE tools to the engineering design group. The resulting application was well-received and restored a fixed price design contract to profitability.



The fact is that the application areas for IE skills are broad as Martin-Vega suggests. Supply chain performance should not be at the mercy of local optimums. Balancing supply and demand more closely calls for creativity and counter-intuitive measures like creating buffer inventory at critical points. Lean, or removing waste from operations, needs to be applied in more sophisticated ways. Matching supply and demand and building in supply chain flexibility will yield higher returns than a string of local cost reductions. The theory of constraints calls attention to relieving or managing bottlenecks because of their impact on revenues. The same principle applies to increasing capacity at a trading partner and adding inventory upstream of supply chain bottlenecks to protect the bottleneck from shortages.

The last paradigm category, how executives measure effectiveness, addresses executive views of measurement. The conventional mindset can be characterized by the absence or presence of any of the listed paradigms. The IE in most organizations will be expected to increase efficiency through cost reductions. Certainly this is a legitimate, but not necessarily complete way to measure IE contributions. Lead-time, cycle time, quality and flexibility also hold value, but they are harder to link to the bottom line. Gross margin return on investment (GMROI), a pre-World War I metric employed by retailers and distributors, measures trade-offs between working capital investment and product profitability. This can be a joint metric shared by operations and marketing functions.

Another mark of progress is often measured by the amount of installed technology. However, technology deployment doesn't mean the technology will be utilized effectively. Andrew McAfee, a professor at Harvard Business School, has called attention to requirements for organizational "complements" to make technology effective. Four cited by McAfee fall directly in the IE skill set. They are the need for better skilled workers, higher levels of teamwork, redesigned processes and new decision rights that empower technology users. Process documentation must address these complements when technology is introduced.

Another perception of effectiveness emphasizes quantity over quality in launching improvement projects. Lack of disciplined project management is one reason. In the November/December issue of *Industrial Management*, Rick A. Morris calls attention to one of the basic problems. Morris states that, despite investments in project management training, more than 90 percent of failing projects do so in

the first five minutes. The problem lies in project chartering and planning. Bad project charter leads to bad project plan leads to failed project. He notes that the overall failure rate is between 60 percent and 80 percent. The Project Management Institute has a considerable body of knowledge in its *PMBOK Guide* and Project Management Professional certification that IEs might pursue.

Vertical and horizontal, or activity-based, accounting follow from the organization-centric and process-centric views. Organizational cost centers collect vertical costs. However, IEs need to use horizontal process costing to justify and measure their results. Often, the CFO will fight this approach so tact is also needed.

Finally, the SCM discipline has elevated the objective of shifting replenishment decisions from forecast-driven to demand-driven. This is consistent with lean approaches that use pull signals to trigger replenishment in process inventories. The IE should measure the degree to which supply chains are demand-driven. The process begins by documenting the replenishment decision points along the chain. These include points in one's own company and at its trading partners. Then the IE should document whether decisions at each decision point are demand-driven or forecast-driven, that is, based on actual downstream demand or a forecast of that demand.

An assessment should evaluate whether each forecast-driven decision can be changed to demand-driven and how it might be done. If there are 10 decision points and two are demand-driven and five could be demand-driven, current performance is 20 percent; potential performance is 50 percent. The tool employed will depend on the nature of the product and operation. Examples are postponement, product redesign, kanbans, data exchange, two-bin type rules or built-in rules for information systems.

IEs must advocate for more effective project portfolios that present solutions for global supply chains. In most companies, participation in this process should be a basic IE responsibility. ~

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