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SUPPLY CHAIN MANAGEMENT REVIEW

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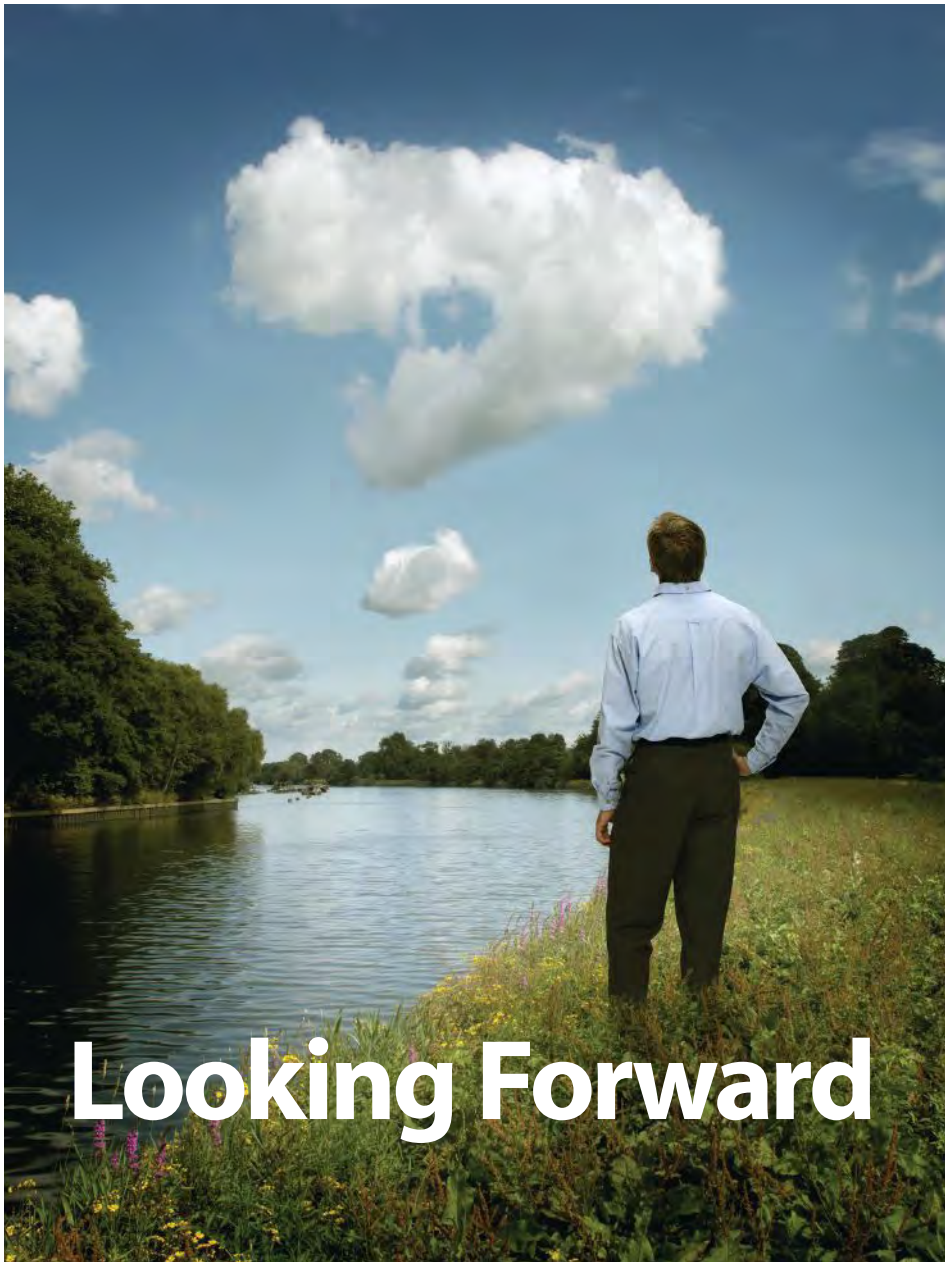

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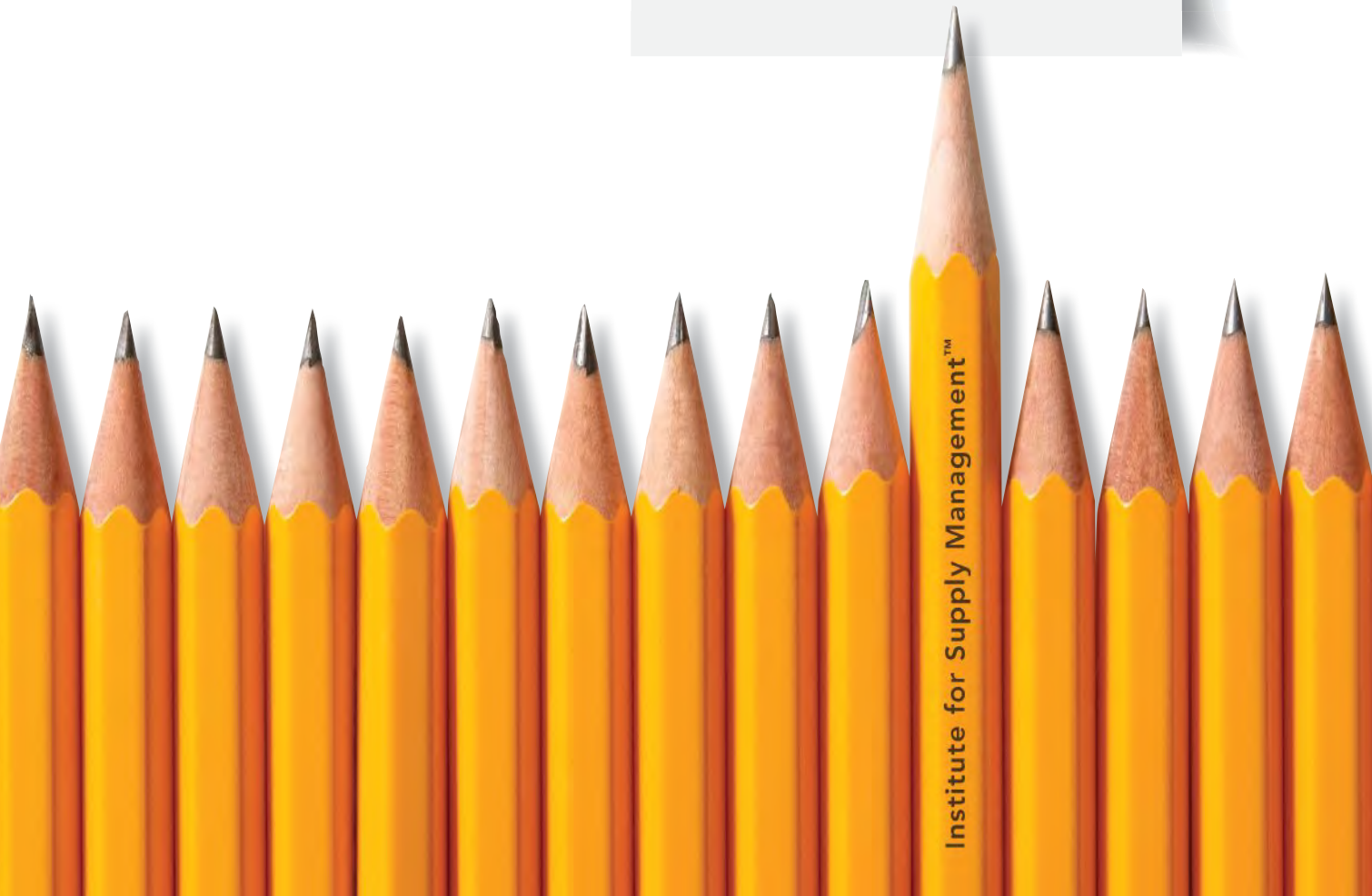

It's Time to Look Forward

Bob Trebilcock, Editorial Director
btrebilcock@peerlessmedia.com

Looking forward. That's the theme of this month's issue of *SCMR*. By looking forward, I'm not just talking about the start of the New Year, which is the traditional time to think about the year ahead. Instead, I'm thinking about the many ways in which the role of the supply chain, and the challenges coming our way, continue to evolve. Those of us who toil in the supply chain have to look forward if we are going to anticipate where our companies—and our customers—are going so that we arrive there first.

This month, we offer a diverse lineup of pieces for the forward-looking organization.

The first, in fact, deals with that age old issue of supply chain visibility. We've all heard about solutions using RFID, sensors, GPS, and cellular technologies to track in-transit shipments in real time. The promise of these solutions is that they not only provide the location of your cargo, but also information about the condition of your product. For instance, you may want to know whether there has been a change in temperature that could affect the salability of the items being transported. The question isn't whether the technologies work as promised, but do they deliver a quantifiable benefit? The answer is "yes," say consultants Joe McKinney and Arthur Radford. In The Delivered Financial Value of In-Transit Cargo Tracking Data, the authors share the quantifiable results of real world studies they conducted between 2005 and 2010.

Attend any supply chain conference these days, and one of the most important issues being discussed is a coming shortage of talent. In A Supply Chain Talent "Perfect Storm," Kusumal Ruamsook and Christopher Craighead identify four key trends that could affect the size of the talent pool in the future should they all come together. The authors also offer five strategies your organization can put in place to ride out the storm and build your organizational talent.

You'll also find a thought-provoking piece on supply chain resilience from Steven Melnyk and his colleagues at Michigan State University. Many organizations are looking at ways to manage the risk in their supply chains. Resilience, on the other hand, is an emerging trend that recognizes that Murphy's Law will still rule the day, despite the best laid plans of a risk management strategy. The question isn't whether something bad will happen, the authors tell us; it's how quickly you can snap back. Moreover, they contend that resilience is a characteristic of supply chains that can be planned and shaped.

Finally, this month we're introducing our new Innovations column from the MIT Center for Transportation & Logistics. Over the next year, and maybe longer, the team from MIT will help us understand how innovation occurs in the supply chain and what it means to the transformation of our businesses.

Like me, I hope you are looking forward—both to the year ahead and to what it means to your supply chain.

SUPPLY CHAIN MANAGEMENT REVIEW

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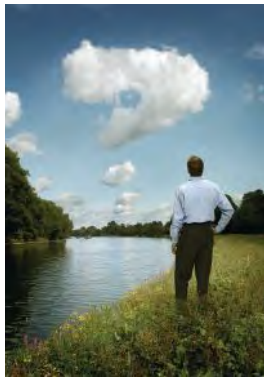

Photo/illustration by Tom Merton

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BY LARRY LAPIDE

Fracking: A Game Changer?

Has the future of oil changed? Or is the dependency on oil here to stay for the long haul?

Dr. Lapide has extensive experience in the industry as a practitioner, consultant, and software analyst. He is currently a lecturer at the University of Massachusetts' Boston Campus and is an MIT Research Affiliate. He received the inaugural *Lifetime Achievement in Business Forecasting & Planning Award* from the Institute of Business Forecasting & Planning. He welcomes comments on his columns at llapide@mit.edu.

This column represents the annual oil update I've been writing since my first column appeared in the January/February 2007 issue of *SCMR*. ("Is Your Supply Chain Addicted To Oil?") As always, Exhibit 1 depicts quarterly imported crude oil prices from the U.S. Government for close to 40 years. Denoted on the chart is the "Era of Cheap Oil," which lasted almost 20 years. During that period, "real" (i.e., deflated) oil prices bounced around from $20 to $30 per barrel. The period also overlapped with the heyday of the Supply Chain Management (SCM) evolution that began in the mid-1990s. Over this time companies started altering their networks to embrace the integration and globalization of supply chains, leveraging cheap oil to lower costs and inventories.

As can be noted from Exhibit 1, real oil prices have been hovering around $100/barrel since the Great Recession, despite the dismal global economy. Prices are now three to four times higher than they were during the Era of Cheap Oil. I've been postulating that once the economy starts growing more robustly, oil prices would steadily rise with greater volatility well past 2020. This would be due to increased global demand and the need to leverage more expensive oil-drilling methods—such as deep-water drilling and shale-oil fracking (an extraction technique)—in order to meet increasing demand. I've been advising managers to alter supply chains to wean them off oil. Future supply chains need to be slower and designed to minimize costs and maximize energy efficiencies, rather than minimize costs and inventories.

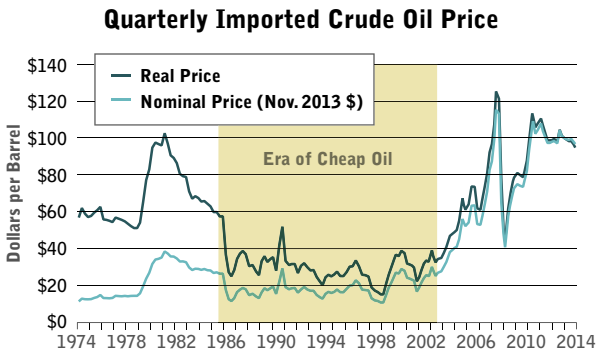
Has Fracking Changed the Game?

This past year, however, has been different than discussed in prior updates; bringing to mind a quote from Yogi Berra that goes: "The future ain't what it used to be." I'm wondering: Has the future of oil changed?

I've thought long and hard about what to say this year because of all the media buzz around shale oil and natural gas fracking as energy saviors, maybe bringing back cheap energy and rendering the big user oil countries less dependent on oil, and less dependent on OPEC and other oil producing countries. Below are some of last year's news items:

• According to the U.S. Energy Department (*Wall Street Journal,* 7/26/13, "U.S. Sees Boom

EXHIBIT 1



Source: EIA Short-Term Energy Outlook, November 2013

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in Global Energy Use:") "The world will use far more of every type of energy in coming decades." Oil, natural gas, and coal, however, will still account for 80 percent of energy use by 2040. Energy use will grow 56 percent from 2010 to 2040, mostly from use for electric power generation and transportation.

- In 2013, the U.S. started producing more crude oil than it imported due to reduced consumption and increased production from fracking. In addition, by 2020 the U.S. will overtake Saudi Arabia as the world's largest producer of oil. Also, the U.S. has achieved self-sufficiency in natural gas, and currently has a surplus.
- Trucking companies are thinking seriously about using liquid natural gas (LNG) fueled vehicles. Large fleet operators such as Lowe's, P&G, FedEx, and UPS have announced initiatives to shift more rapidly from diesel to natural-gas fueled vehicles.
- Much of the additional natural gas is going to fuel electric power plants that were burning coal (the dirtiest carbon-based fuel). However, it has been recently reported that fracking sites are depleting faster than expected in comparison to traditional oil and gas extraction sites (*USA Today,* 11/04/13,"Could the fracking boom run dry?"). The Energy Information Administration projects that U.S oil production is expected to increase until 2019 and decrease after that. This means that the potential for shale oil and gas fracking to ameliorate some energy issues may be less optimistic than originally thought.

Still Heavily Affected by Oil Pricing

Does the above information say the future energy picture has changed for supply chain managers? I think not. While the long-term picture might change, cheap oil is out of the picture. In the short term, it won't change much because it takes years to materially affect and alter supply chains, including the fact that the energy supply chain itself must change. However, while the long-term looks to be rosier re: oil dependency, this too is uncertain and not as optimistic as one might initially think.

Supply chains will still be dependent on the vagaries of oil prices because they will still be using oil or because other energy sources will be priced in lockstep with oil pricing. For the next couple of decades oil will stay the preferred energy source. Oil dependency will vary in three aspects of SCM: 1) materials, components, and packaging, 2) energy used to operate manufacturing & distribution equipment and facilities, and 3) transportation services.

Much of today's materials, components, and packaging are oil-based plastics. Over decades there has been a significant shift from being largely composed of glass, metal, and paper to plastic. With the recent rise in oil prices a shift away from plastic to paper-based packaging, for example, has begun. The shift from oil-based will continue indefinitely, and for this aspect, natural gas is not a replacement for oil.

The energy used to operate equipment and facilities is largely electricity with some oil-based diesel. So this aspect does not represent a significant portion of oil-based usage in supply chains. In the long run this minor portion of oil dependency will grow, but will not be the major focus area in which to reduce oil dependency.

Transportation is the major portion of oil dependency for supply chains. Moving goods around represents a sizeable portion of oil usage today, much in the form of diesel.

Transportation is the major portion of oil dependency for supply chains. Moving goods around represents a sizeable portion of oil usage today, much in the form of diesel. It is clear that the transportation industry is planning to shift as rapidly as possible to LNG fuel. The question is: How rapidly can that shift really occur? First, the truck manufacturers need to start making natural-gas fueled trucks in large volumes. Long-haul trucks, for example, are still on the drawing board. Then it will take more than a decade to replace the trucks on the road, as well as to establish a network of LNG stations to replace the vast network of diesel-fueling stations.

Therefore the demand for LNG will take decades to come to fruition. Meanwhile on the supply side, LNG has issues in terms of how fast sites are depleting; so more time than originally anticipated might be needed to find and tap into natural gas reserves. In short, looking at the supply-demand picture, it will take decades to shift the lion's share of diesel to LNG.

To summarize, my view has not been altered by the recent news around fracking. Managers should continue to make their supply chains more energy efficient, because the dependency on oil is here to stay for quite some time. □

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BY PATRICK BURNSON

When it Comes to Risk Management, Think Small

Analysis shows no correlation between a manufacturer's total expenditure with a supplier and the cost of a supply disruption. Evaluating sub-tier partners is key.

Patrick Burnson is the executive editor at *Supply Chain Management Review.* He welcomes comments on his columns at pburnson@ehpub.com

INDUSTRY ANALYSTS AGREE that it's important to make risk assessment an ongoing process, allowing for frequent plan updates as political conditions, fuel prices, tariffs, currency exchange rates, labor costs, and other supply chain security threats arise. Until now, the focus for most U.S. manufacturers has been on protecting its most asset-intensive suppliers, to ensure that key high-value components are always available. But a new body of research on supply chain risk suggests there may be no correlation between the total amount a manufacturer spends with a supplier and the profit loss it would incur if that supply were suddenly interrupted.

This finding defies a basic business tenet that equates the greatest supply chain risk with suppliers of highest annual expenditure.

When applied to Ford Motor Company's supply chain, the quantitative analysis by Professor David Simchi-Levi of MIT's Department of Civil and Environmental Engineering and Engineering Systems Division shows that the supply firms whose disruption would inflict the greatest blow to Ford's profits are those that provide the manufacturer with relatively low-cost components.

"This helps explain why risk in a complex supply network often remains hidden," says Simchi-Levi, who is co-director of MIT's Leaders for Global Operations program. "The risk occurs in unexpected locations and components of a manufacturer's supply network."

A paper on the application of this work to Ford's supply chain by Simchi-Levi and former graduate students William Schmidt, now an assistant professor at Cornell University, and Yehua Wei, an assistant professor at Duke University, will appear in the January/February issue of *Harvard Business Review.*

Focus on Low-probability, High-impact Risk

Traditional methods for identifying the suppliers and events that pose the highest risk depend on knowing the probability that a specific type of risk event will occur at any firm and knowing the magnitude of the problems that would ensue. However, risks—which can range from a brief work stoppage to a major natural disaster—exist on a continuum of frequency and predictability, and the sources of low-probability, high-impact risk are difficult to quantify. Manufacturers generally assume their greatest supply-chain risk is tied to suppliers of highest expenditure.

But Simchi-Levi reasoned that because a company's mitigation choices—maintaining more inventory or an alternative supply source, for example—are the same regardless of the type of problem that occurs, a mathematical model of supply-chain risk should determine the impact to the company's operations if any disruption occurs, rather than estimating the probability of specific types of risks.

His model incorporates bill-of-material information (the list of ingredients required to build a company's products); maps each part or material to one or more of the firm's facilities and product lines; captures multiple tiers of supplier relationships (tier 1 are direct suppliers, tier 2 are suppliers to tier 1 firms, and so on); includes operational and financial impact measures; and incorporates supplier recovery time if a problem occurs.

As nodes are removed one at a time from

the supply network, the model determines how best to reallocate inventory and obtain alternatives, and predicts financial impact. The resulting analysis divides suppliers into three segments depending on the cost of the individual components they provide and the financial impact their shortage would have: low-cost components/high financial impact; high-cost components/high financial impact; and low-cost components/low financial impact.

Highest Risk From 2 Percent of Suppliers

When Simchi-Levi, Schmidt, and Wei applied the model to Ford's multitier supply network — which has long lead times from some providers, a complex bill-of-materials structure, components that are shared across multiple product lines, and thousands of components from tier 1 suppliers — the model predicted that a short disruption at 61 percent of the tier 1 firms would not cause profit loss. By contrast, a halt in distribution from about 2 percent of firms would have a very large impact on Ford's profits. Yet each of those firms in the 2 percent furnishes Ford with less-expensive components rather than, say, expensive car seats and instrument panels that fall into the high-financial-impact segment.

"The ability to manage and respond to supply chain disruptions is becoming one of the critical success factors of executives," says Hau Lee, a professor of operations, information, and technology at Stanford University's Graduate School of Business, who was not involved in the study. "Addressing low-probability disruptions has often been viewed as black magic, as standard quantitative methods simply do not work. The authors have come up with an innovative, structured approach, so that executives could use a rational decision process to gain control of this problem."

The relevance of this methodology can be seen in light of a disruption in 2012 at a plant in Europe, which caused a shortage of a polymer used by most manufacturer-suppliers to make fuel tanks, brake components, and seat fabrics. It took six months to restart production, a delay that had a large financial impact on the auto industry.

Keeping Track of Supplier Solvency

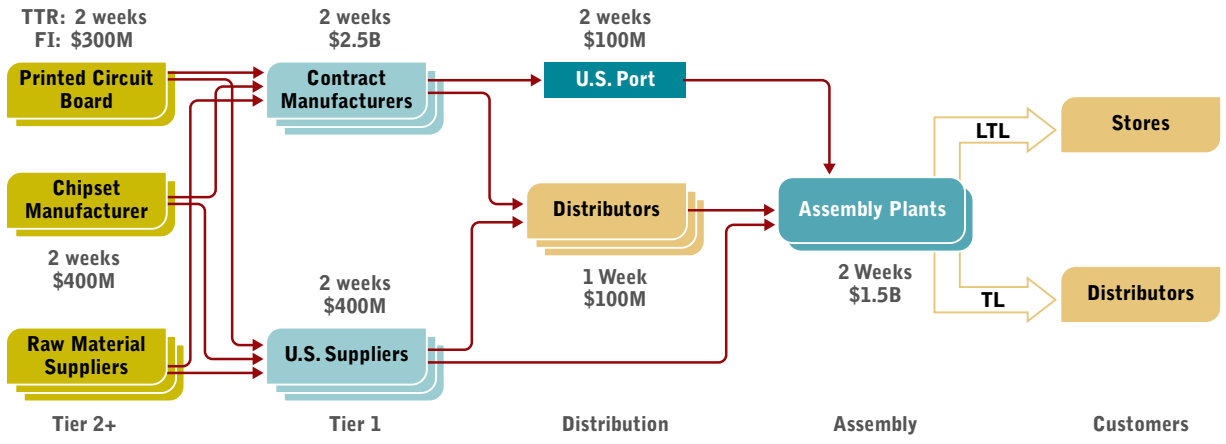
Creating back up plans and due diligence reports for smaller suppliers should also be a priority says Rose Kelly-Falls, senior vice president, Supply Chain Risk Management at Rapid Ratings International, in Indianapolis, Indiana. She posed this rhetorical question to shippers last year: Are supply chain managers paying proper attention to their suppliers' solvency?

From her point of view, the answer is a resounding no. "Solvency is the degree to which current assets exceed liabilities," she explains. "If supply chain managers miss any 'red flags' in this area, they do so at their own peril."

Kelly-Falls likes to tell a story about a small private machining company that was a second-tier supplier of clutch gears for a major U.S. auto manufacturer. It was located in a remote community, and was quietly purchased by a toy manufacturer without much fanfare.

"When the auto maker needed a crucial piece of equipment for a new product launch, it was suddenly unavailable," she recalls. "Why? Because this big multinational corporation did not ever bother keeping track of what it perceived to be a minor business partner." The result, she recalls, was a missed deadline and the loss of millions of dollars in revenue. Had the relationship not been underestimated, the risk could have been mitigated. □

An Illustrative Example: High Tech Manufacturer's Risk Exposure Index



- **Time-To-Recovery (TTR):** The time it takes to recover to full functionality after a disruption
- **Financial Impact (FI):** Lost sales during TTR
- **The Risk Exposure Index (REI)** is the maximum FI over all nodes in the supply chain

Inapt Innovations Can Do More Harm Than Good

By Jim Rice

Jim Rice is Deputy Director, MIT Center for Transportation & Logistics. He can be contacted at: jrice@mit.edu.

Editor's note: *This is the first in the series of* Innovation Strategies *columns from the MIT Center for Transportation & Logistics. In the coming issues, MIT CTL will explore the development and implementation of innovative supply chain solutions and practices. For more information, visit http://ctl.mit.edu.*

Revolutionary innovations capture the imagination and motivate people. But how many supply chain innovations (SCI) are truly revolutionary?

Not many, according to a recent study of SCI carried out by the MIT Center for Transportation & Logistics (MIT CTL)*. Most innovations in supply chain management build on existing achievements and reconfigure known methods and technologies rather than invent new ones. That doesn't mean SCI is unexciting or largely irrelevant. On the contrary, incremental change represents one of the most powerful weapons companies have to stay ahead of the competition (see table). And, of course, some SCI's do redefine markets. But in order to fully harness SCI, companies must distinguish between the steady and step-change varieties, and understand what it takes to implement them in terms of the organization's strategic objectives. Inapt execution of an innovation can lead to costly missteps, particularly in today's fast-paced competitive environment. Recall, for example, how companies misjudged the potential of early-stage RFID applications.

Let's explore the nuts and bolts of SCI in an effort to help supply chain practitioners properly evaluate and exploit innovations. But first, let's take a closer look at the difference between "cool" innovations that bring drastic change and incremental advances that move companies forward at a steadier pace.

Contrasting Strategies

In his seminal work "The Innovator's Dilemma," thought leader Clay Christensen describes two types of product innovation: sustaining and disruptive. Sustaining innovations make products better through, say, lower prices or added features, thus sustaining the enterprise's market position. Disruptive innovations change the product offering by redefining the value proposition.

SCI can be sustaining or disruptive, too. And although process innovations tend to follow a different path than those in the product world, there are some important parallels.

For example, our research indicates that sustaining SCIs improve the process, perhaps by lowering costs, shortening cycle times, and raising the quality bar. These innovations also help to sustain a company's competitive position.

Similarly, just as disruptive innovations change product offerings, so too do disruptive SCIs change the product process. More specifically, they are evident when an organization challenges or changes the dominant design. While the supply chain does not actually alter the product, it can change how the offering is produced and delivered to customers.

The "dominant design" is a concept developed by MIT professor Jim Utterback to explain the evolution of product markets. Utterback's work highlights how product and process innovations follow different evolutions. Briefly, in the early stages of a new product, multiple variants of the process often emerge as process innovation increases. Eventually these variations coalesce into a common or dominant process design. Some time after that, the evolutionary pace trails off and the opportunities for significant change diminish until the next "Big Idea" comes along.

Some innovations can be both sustaining and disruptive. For instance, the Dell computer product line that was tailored to suit a clearly defined customer segment can be considered a sustaining innovation; it made demand more predictable and the supply chain more efficient. Yet, when Dell designed its supply chain to make-to-order and ship-direct at a time when virtually all other large manufacturers were producing to stock (i.e. the

dominant design) and selling through retail, these constituted a disruptive SCI because the shift changed the process used for production and distribution

Zara's strategy to co-locate its design and production centers in close proximity to end markets created efficiencies that made the apparel company's process quicker and more responsive; that was a sustaining SCI. At the same time, the coupling of a high-automation, near-market, fast-cycle time with a vertically integrated supply chain represented a disruptive SCI. The new model challenged the dominant design of low automation, remote manufacturing, long cycle time, and an outsourced supply chain.

The Wrong Fit

While many of us are captivated by SCIs that challenge the dominant design, in reality, most SCIs are sustaining. This is consistent with the time-honored operational goals of speeding up product introductions, lowering costs, and improving quality. These goals have been called many things including business process reengineering (BPR), continuous improvement, cost cutting, and kaizen.

The name is not important—but a clear understanding of the core processes is essential. Leaders tend to be inspired by disruptive SCIs (even though they often confuse them with product innovations), and demand dramatic change even when they lack a thorough understanding of the processes involved. In some cases senior executives may not appreciate that a sustaining strategy is the better choice, and requires a different approach to those needed for radical disruptive strategies.

Another stumbling block to achieving disruptive change is that embracing this type of SCI is very difficult. We believe that disruptive SCIs represent the supply chain equivalent of Christensen's Innovator's Dilemma. On the one hand, market-leading supply chains have to operate at an economic scale, and be efficient as well as consistent. On the other hand, adopting a disruptive supply chain design tends to upset the status quo and undermine the supply chain's performance.

To further complicate the picture, taking the safer or more convenient sustaining option can be the wrong choice in some situations. For example, a CPG company attempted to enter an emerging market by using a high-volume production system for a highly sophisticated consumer product. The strategy was unsuccessful. Consumers could not afford to buy the product, sales volumes were too low to warrant the high-volume approach, and the production system depended on an underdeveloped supply base.

A radical departure from the dominant design was needed. That was one that required the company to design and manage a low-volume, emerging market supply chain for which it had no expertise. Fortunately, a local supply chain operative created a cost-effective, low-volume operation to serve the local market—much to the company's surprise.

The Cost of Confusion

The above example illustrates a broader and more serious outcome of misjudging the type of innovation required in a given competitive situation: The subsequent failure of an inapt innovation deters companies from pursuing market opportunities.

In the case of the CPG Company, making a lower quality product based on a low-volume supply chain probably never occurred to the organization. These leaders were forced to experience deep failure before they could see and embrace the potential that existed with a disruptive SCI. Most enterprises are not so lucky.

Before pursuing an SCI, a company has to be clear about the objective; is the goal continuous improvement to maintain market position with a modest increase in margin or to disrupt the industry? Many managers get starry-eyed over the latter objective but actually need to target the former.

Corporate leaders intent on pursuing disruptive SCIs should prepare for a roller coaster ride because the disruptive forces unleashed may affect their company. Still, being aware of consequences like these can prepare the enterprise for the adventure. And as mentioned, the majority of SCIs tend to be sustaining. We ought to pursue these innovations aggressively and cheer their successes, whatever we call them. □

TABLE 1

Examples of Supply Chain Innovations (SCI)

Company	SCI
Caterpillar	Service parts availability via integrated network
Cisco	Proactive and upstream SC risk management, monitoring, and measurement
Dell	Make-to-order, sell direct, product & SC tailored to market segment
FedEx	Hub-and-spoke system and network
Ford	Vertically integrated assembly line at River Rouge plant
Intel	Copy Exactly! standard fab designs
Li & Fung	Complete upstream contract manufacturing management
Lucent	Platform/component standardization, supplier contract margin management
P&G	Diamond relationship customer teams, Streamlined Logistics, Efficient Consumer Response, Continuous Replenishment
Reebok	Responsive supply chain via product redesign, postponement, and nearshoring
Toyota	Toyota Production System, SMED (single-minute exchange of dies)
UPS	IT integration across system, standardized/engineered processes
Walmart	Everyday Low Prices, upstream SC management, store location impact on SCs
Zara	Hi-automation and near-market production aligned for SC for fast fashion

**For a more detailed account of the MIT CTL SCI study, including an extensive matrix of innovation types, download the white paper here: http://ctl.mit.edu/research/scinnovation.*

A Supply Chain Talent

In the rush for talent, a storm may be brewing that will contract the pool for supply chain talent. There are strategic actions that enterprises can take before the winds and waves hit shore.

By Kusumal Ruamsook and Christopher Craighead

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"Perfect Storm?"

In *The Perfect Storm*, Sebastian Junger chronicled the story of the six crew members on board the Andrea Gail, a swordfish boat out of Gloucester, as they battled a once-in-a-century meteorological cataclysm off the coast of Newfoundland in October 1991.

The devastating storm was created by the confluence of three extreme meteorological forces: an icy cold high pressure system, a low pressure system, and the remnants of tropical Hurricane Grace. It was a colossal winter-summer collision of an Arctic storm and a tropical hurricane. When the low pressure system met the high pressure system, they formed a non-tropical Atlantic storm that later absorbed Hurricane Grace. Such events are rare, but when they happen, they bring forth enormous amounts of destructive energy. During *The Perfect Storm*, gale force winds "blasted over the ocean at more than 100 mph. Ocean waves peaked at 100 feet, the height of 10-story buildings," wrote Beth Nissen, a reporter for CNN.com. As anyone who has read the book or seen the movie knows, the ship and crew succumbed to the power of the wind and waves.

Based on our research, which was supported by the Center for Supply Chain Research (CSCR) at the Smeal College of Business, at The Pennsylvania State University, we believe a supply chain talent perfect storm could be in the offing. Our conclusions were drawn from a review of the literature, reports from key organizations, and a Supply Chain Leaders Forum (SCLF) sponsored in October 2012 by CSCR. The Leaders Forum brought together more than 70 top supply chain and human resource professionals from a variety of companies and industries to address the challenges stemming from supply chain talent.

Based on our review, we have observed a number of key emerging trends that individually create tension and potential disruptions in the supply chain talent pool. Either of those on their own can create challenges for a supply chain organization similar to a hurricane or a severe winter gale. At the same time, like *The Perfect Storm*, there is the prospect of these trends colliding to create a supply chain talent "perfect storm."

The goal of this article is not to take a strong stance on if or when the storm will occur; like the weather, that is hard to predict. Rather, consider this paper a "storm warning." Just as serious seafarers knowledge of atmospheric conditions is a large part of seamanship, proactive organizations need to recognize the importance of understanding the vagaries of the business atmosphere in devising business strategies. In the following, we describe key emerging trends in supply chain talent that individually create tension in the supply chain talent pools, along with strategic recommendations to weather and survive any coming storms.

A Tetralogy of Supply Chain Trends

At least four trends—a tetralogy—are forces of increasing magnitude that create strains in the supply chain talent pool (Exhibit 1 on the following page). They include:

1. Industry Demand for New Supply Chain Talent
2. Supply Chain Talent Gaps
3. Supply Chain Profession Dynamics
4. Potential Business Faculty Shortages

Each of these four has an impact on the others.

1. Industry Demand for New Supply Chain Talent

The demand for supply chain talent has been on the rise across industries and types of logistics and supply chain positions. According to the U.S. Bureau of Labor Statistics, jobs in logistics are estimated to grow by 26 percent between 2010 and 2020, an average growth rate that is nearly twice as fast as 14 percent of all occupations. The supply chain job growth has been affirmed by a variety of industry associations. For instance, CSCMP's Career Center reported "very strong" hiring activity and job postings for all types of logistics and supply chain positions in 2011 and 2012. Similarly, surveys conducted by the Institute for Supply Management (ISM) indicated steady and strong climbs in hiring in both manufacturing and nonmanufacturing sectors in 2011. Already, demand for supply chain professionals is estimated to exceed supply by a ratio of six to one, according to R.J. Bowman, author of *The Secret Society of Supply Chain Management*.

Zach Blanton

EXHIBIT 1

A Tetralogy of Supply Chain Talent Trends

Industry Demands for New Supply Chain Talent

Estimated demand for supply chain professionals exceeds supply by a ratio of six to one. The high level of hiring activity for all types of logistics and supply chain positions, combined with a significant decrease in expected layoffs in 2011 to 12, create the level of net job growth in the operations and supply chain management professions that is not only the highest since the global recession began, but also higher than the average for all occupations.

Supply Chain Talent Gaps

More than 60 million Baby Boomers will exit the workforce by 2025, but only 40 million new bodies will enter, creating a "hollowed-out middle" and even senior-level management positions.

Potential Business Faculty Shortages

The shortfall of new business doctorates available for faculty employment is estimated at 2,500 by 2014. Of current full-time business faculty in the United States, only about 1 percent is in supply chain management/ transportation/logistics field.

Supply Chain Profession Dynamics

As an industry, supply chain is evolving as a highly educated sector rich in "hard" analytical skills. However, three out of four jobs in supply chain will change by 2015, suggesting that being rich in "hard" skills is no longer sufficient. A set of "soft" and "hard" skills, leaderships, and cross-functional competencies essential for professional and organizational success in the 21st Century will continue to broaden and constantly evolve.

2. Supply Chain Talent Gaps

The gap between the demand and availability of supply chain professionals is only going to get wider. Consider that there are an estimated 76 million Baby Boomers in the United States who are turning 65 at the rate of one every eight seconds, according to a report by Steve Minter in *Industry Week*. At this rate, the US Census Bureau projects that more than 60 million Baby Boomers will exit the workforce by 2025. Given that there are fewer GenXers than Baby Boomers, only 40 million new bodies will enter the workforce. As a result of this demographic trend, talent shortages that already surfaced at most occupational levels in supply chain are most acute in mid-management positions (a "hollowed-out middle") and even senior-level management positions.

3. Supply Chain Profession Dynamics

It's not just that there is a smaller pool of potential professionals available for the future, there is also a growing skills gap that is exacerbated by the transition from *industrial* economy to *information/service* economy.

By all accounts, today's business environment demonstrates less standardization, higher complexity, longer learning cycles, higher dynamics, and higher degree of talent intensity. For evidence, consider that jobs requiring highly skilled professionals continued to grow even during the recent recession. Accordingly, supply chain as an industry is evolving as a highly educated sector rich in professionals with "hard" analytical skills.

However, the ongoing transition to a knowledge-based, globalized economy carries with it changing supply chain profession dynamics. In fact, it is projected that three out of four jobs in supply chain will change by 2015, and that 60 percent of all new jobs in the 21st century will require skills that only 20 percent of the workforce possesses. For supply chain as an industry, this means that being an industry rich in "hard" analytical skills is no longer sufficient.

On the contrary, a set of skills, leadership, and cross-functional competencies essential for supply chain professional and organizational success in the 21st century will continue to broaden and constantly evolve. Already, there is a shortage of highly skilled workers who possess those broader business skills.

4. Potential Business Faculty Shortages

What about the capacity of academia to create new talent? The outlook does not look sunny on that front either. According to the *International Business School Data Trends*, published by the Association to Advance Collegiate Schools of Business (AACSB), the number of full-time business faculty in supply chain management, transportation, and logistics has been consistently below 1.5 percent of all-field business faculty both in the United States and worldwide.

With an average of just 365 U.S. supply chain business faculty members between 2009 and 2013, this relatively diminutive body could shrink even further given the pending retirements of baby boomer-aged faculty. Adding to the predicament is the somber outlook for the number of new doctorate graduates available for faculty employment in U.S. universities, despite the fact that more than half of business doctorates graduated each year earned their degrees from U.S. schools. According to the Doctoral Faculty Commission, the shortfall of new business doctorates by 2014 is estimated at 2,500.

A number of factors are contributing to these shortfalls. For one, at least 15 percent of new doctorates choose to take government or industry positions rather than academic positions, while many others are hired to teach outside of the United States. For another, the

A number of key trends are emerging that can create tension and potential disruptions in the supply chain talent pool on their own. At the same time, like *The Perfect Storm*, there is the prospect of these trends colliding to create a supply chain talent "perfect storm."

number of new students accepted into business PhD programs in U.S. universities has been weakened by tough budget pressures. Finally, the PhD completion rate is lugubrious: Almost half of all new business doctoral students do not complete their degree programs, resulting in the perceivably slim number of business-doctorates-to-be.

The ramification of the latter two factors can be gauged from the National Science Foundation (NSF)'s *2011 Survey of Earned Doctorates from US Universities.* According to the survey, the number of doctorate recipients in business and management averages 2.8 percent of doctorate recipients in all fields of study during 2001–11 vs. approximately 16 percent in science and engineering fields.

The Supply Chain Talent Perfect Storm

The deleterious effects of each of these forces on the availability of supply chain talent are already individually at play. What happens if they collide and converge? They could create a supply chain talent "perfect storm" that could have severe repercussions:

- **Breadth**—The effects could permeate across all supply chain functions.
- **Depth**—The effects will be felt from top to bottom.
- **Longevity**—The effects won't simply blow over quickly.

In essence, organizations in the midst of the storm will find it increasingly difficult to simultaneously search for the right talents to back-fill those who retired or about to retire, raise the skill sets of existing talents to meet the needs of a changing environment, and groom high-potential talents into future supply chain leaders. What's at stake here?

While the talent shortage could affect value creation, performance, and competitive advantage in many ways, the underlying theme in all of them boil down to a single strategic asset: supply chain knowledge (SCK). That's the knowledge of the products, processes, and partners within the supply chain.

How important is SCK? Paramount! For example, a recent meta-analytic study examined the data from 35 published academic papers on supply chain knowledge and performance. The authors concluded that SCK was a significant indicator of the performance of supply chain organizations. "While firms most likely want to devote time and money to cultivating a variety of strategic resources," the authors wrote, "their investments in building SCK may offer particularly handsome returns."[1] Unfortunately, the ability of organizations to invest in SCK in the future may be significantly hampered by the perfect storm.

Five Strategies to Weather the Storm

While specific activities of talent management differ by organization, talent management programs at organizations participating in the Supply Chain Leaders Forum have certain characteristics in common. The most important is that they have developed future-focused, integrated talent management programs that are aligned with corporate strategies. Underlying these programs are five strategies contrived to ensure that the organizations are prepared to stay afloat in the midst of the perfect storm.

Strategy 1: Prepare the vessels by constituting employee value propositions

Sailors prepare for heavy weather by ensuring that the vessel is structurally sound, well provisioned, and outfitted with proper operating, maintenance, safety, and emergency gear and systems.

To prepare for the supply chain talent perfect storm, organizations' talent management programs need to have structurally sound employee value propositions that span opportunity, work, rewards, people, and organization. Specifically, employees should be provided with a career roadmap and opportunities to acquire the skills they need to climb the leadership ladder and broaden their career potential. These roadmap and opportunities, as well as

compensation and incentive programs, should be designed to reflect individual skill assessment (to identify skill gaps), learning pace and style, and personal objectives such as progress in life and career. All activities must be accompanied by specific goals and timelines against which each individual is evaluated and development plan updated.

Strategy 2: Plot safe passage by mapping talent needs

When a storm is gathering at sea, the first and foremost strategy is to work out the vessel's current position and plot the safest course to sail through the stormy water. This action also means that one continues to keep an eye open for changing conditions that render the current forecast obsolete and revises the course as needed.

In a similar vein, mapping talent needs entails identifying the "must have" competencies required by an organization. That is followed by an assessment that identifies the disparity between existing skill sets, must-have abilities and the skill sets that are integral to meeting business strategies. Such a competency framework needs to be future-focused and future-proofed by continuously reevaluating and updating the pivotal skills that will be required in the future to compete in an ever-changing business environment. The goal is to ensure that talent is recruited, developed, evaluated, and compensated in line with the performance needs of the business. To achieve this goal, a flexible architecture of talent management programs is important for organizations' ability to adapt and revamp their approaches accordingly.

Strategy 3: Batten down the hatches by focusing on retention

In inclement weather, seafarers once used strips of wood called battens to secure covers over the hatches, preventing the loss and damage of the precious cargo on board.

In general, supply chain executives expect their most talented employees to leave at some point. However, a tremendous amount of voluntary turnover is occurring today, despite an uncertain economy. The upward trend of voluntary turnover rates is likely to become even more pronounced in the future because of the free agent mentality—the willingness to leave current employer for more money and/or for a bigger career opportunity—particularly among young professionals. In fact, voluntary turnover rates are increasing significantly in Generations X and Y that currently accounts for more than half of the U.S. workforce, compared to older Baby Boomer and veteran counterparts. Supply chain organizations that want to weather the storm need to batten down the hatches and protect their most valuable employees during inclement weather.

Strategy 4: Reef your sails by investing in talent and leadership development

To guard against the adverse effects of strong wind during heavy weather, seafarers reef their sails to reduce the area of a sail exposed to the wind. The rule of thumb is to reef before it is needed as it is always easier to reef the sails before rather than during a storm.

To reduce exposure to the supply chain talent perfect storm, professional development plans are increasingly used to convert a critical mass of "labor" into "talent and leadership." This strategy is reflected in the fact that a particularly popular track for new entrants into the supply chain management and logistics field is professionals who earned non-logistics/SC-related undergraduate degrees and learned through their employers' development programs. Not surprisingly, there has been a steady increase in investment in high-potential and leadership development, and increase career path opportunities.

Certain traits distinguish heavy-weather talent development programs from traditional counterparts.

First, heavy-weather development programs balance a mix of formal programs, such as university courses and expertise development and certification, and informal programs, such as on-boarding processes, on-the-job training and mentoring programs.

Second, the heavy-weather development programs shift from training to learning, and from traditional tower-focused to T-shaped talent development approach. The learning-based, T-shaped approach hones in on core supply-chain technical skills, while simultaneously embracing leadership and globally integrated, cross-functional capabilities.

Commonly implemented programs are global mobility

Supply chain organizations that want to weather the storm need to batten down the hatches and protect their most valuable employees during inclement weather.

programs and job rotations or cross-functional assignments. The former, global mobility programs, help develop the next leadership generation by creating opportunities for individuals to become more culturally aware and apt in a globalized business world. The latter, job rotations, aim to broaden the perspectives of functional specialists in terms of the roles and responsibilities as well as the opportunities and challenges inherent in managing diverse value-added activities throughout the organization.

Unlike those in traditional programs, job rotations in heavy-weather development programs are not limited to related disciplines, such as procurement, manufacturing, and logistics, but also include nontraditional areas like human resources and marketing, to develop talents with domain knowledge and establish relationships in broader areas of the organization. As an example, Ingersoll Rand uses the "2 x 2 x 2" rule that a senior manager must meet; that is, she/he must work in at least 2 different business units, in two different functional areas, and in two different countries, according to *Industry Week's* Minter.

Strategy 5: Stem the tide by landing top talent early for the next decade

Nautically speaking, a ship stems the tide when she intentionally sails against the tide at such a rate that she is able to overcome its power, thus preventing the mounting force of the tide from stalling or capsizing the ship.

Stemming the tide in this context calls for the creation of a talent pipeline, notably for positions that are typically difficult to acquire, by collaborating with colleges, universities, and even high schools.

This strategy allows the organizations to introduce high school juniors and undergraduate seniors to supply chain careers, hence raising the level of awareness of the profession in order to encourage more young people to enter the field. In addition, the organizations are more actively engaged in various educational activities, such as the following:

- Participating in developing industry-driven curriculum.
- Offering scholarships to students based on scholastic achievement and interest in pursuing careers in the supply chain management field.
- Offering paid internships or sponsoring projects, consulting assignments, and/or research that provide real-world experiences and help foster development of future supply chain executives.
- Being "guest lecturers" to better disseminate insights from industry into supply chain programs to support the development of theory into practice.

In effect, this industry-academic collaborative relationship is mutually advantageous to both parties. The industry is able to land work-ready supply chain talents early for the next decade; while the academic institutions are able to stay informed about the changing educational needs of industry to auspiciously further growth and development of supply chain education programs. Conceptually, these efforts could be thought of as "customer managed inventory."

Will the supply chain storms collide? And if so, when? We're not sure. However, the steps supply chain organizations take now could mean the difference between riding out the storm or sinking under the waves.

Footnotes:

1 Wowak, K. D., Craighead, C. W., Ketchen, Jr., D. J. & Hult, G. T. M. (2013): Supply Chain Knowledge and Performance: A Meta-Analysis. *Decision Sciences* 44 (5), pp 843-875.

The Delivered Financial Value of In-transit Cargo

By Joe McKinney and Arthur Radford

Over the years, information about changes in the condition of goods in-transit has been considered untraceable. Today, however, actual field trials have demonstrated the financial value of precise real-time information from the operational supply chain.

Over the last 40 years businesses have increased their use of information technology to collect, report, and analyze data that may be used to improve the future performance of the business process being studied.

The focus of most supply chain managers has been on the demand side of their businesses, especially through progressively more precise methods of collecting data about items being sold as they move through the chain. That information has included the tracking of inventory on hand, the management of purchase orders, the receipt of goods at distribution centers, and point of sale (POS) information about the demand for those goods.

Supply side managers have also collected information. Historically, however, that has been limited to information similar to the demand side of the supply chain, but in different units of measure. Rather than track individual salable units, supply side managers have tracked the case quantities received from production or suppliers, the quantities on hand, and the quantities shipped to customers in container, pallet, and case pack volumes.

The missing piece has been precise, real-time data about events that occur in-transit during the transportation process that can impact the eventual salability of goods once they reach their final destination. Once considered untraceable and unquantifiable, factors such as product tampering, theft, variation in

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Arthur Radford has advised QinetiQ NA on the development of its asset management solution and is currently working on with the EU and US-based asset management and tracking service providers on asset management solutions. He can be reached by email at AHRWRK@aol.com.

Hiroshi Watanabe

Tracking Data

temperature, the presence of moisture when a dry shipping conveyance is important, or the effects of being dropped or other shock damages have historically been considered a cost of doing business.

Because precise visibility into the root cause of these damages has not been available, the market created various imprecise mechanisms to cover these losses. Manufacturers often grant a standard "shipping damage" deduction, or the buyers may simply take involuntary deductions from payments to suppliers. These standard allowances are typically based on some averaged experience of damages. Buyers, sellers, and transportation providers alike purchase insurance coverage against potential loss or damage claims so that the owner of the product at the time of the damage or disappearance can receive financial compensation for the loss of salable product.

We believe that environment is ripe for change. The installation on or in shipping containers and other conveyances of standard technologies such as wireless communications, GPS location tracking, remote sensors, and AutoID solutions such as RFID make it possible for supply side managers to collect precise, real-time information about events as they occur during transportation, take proactive steps to mitigate those events, and quantify their impact on the Total Cost Of Goods Sold.

These technologies were first known as Container Security Devices (CSDs) because they were invented to protect against the use of loaded shipping containers as weapons of mass destruction. With the realization that the commercial value comes from uses other than simply security, the term Container Monitoring Device (CMDs) became popular, and now the U.S. Department of Homeland Security is using the term "Reusable Electronic Conveyance Security Devices" (RECONS). Whatever they are called, these devices and their backroom systems provide solutions to collect and share data and information about the in-transit portion of normal supply chain operations that have until now been invisible to supply chain managers. The question most supply chain managers need to ask is whether this precise information can improve their operations and business in the same way that demand side information has improved inventory management, replenishment, and stocking decisions.

Simply stated, we believe the answer is yes. Studies conducted between 2005 and 2010 at IBM, Dow Chemical, Transmed, Royal Foods, Target Stores, and Alicorp as well as less rigorous analyses for JF Hillebrand, General Motors, and Marks & Spencer's are the basis for the authors' Cost of Goods Sold (CGS) conclusions. Although the exact results at each company are confidential, these results have been demonstrated in one form or another in nearly every analysis the authors have performed.

New Solutions, Real Results

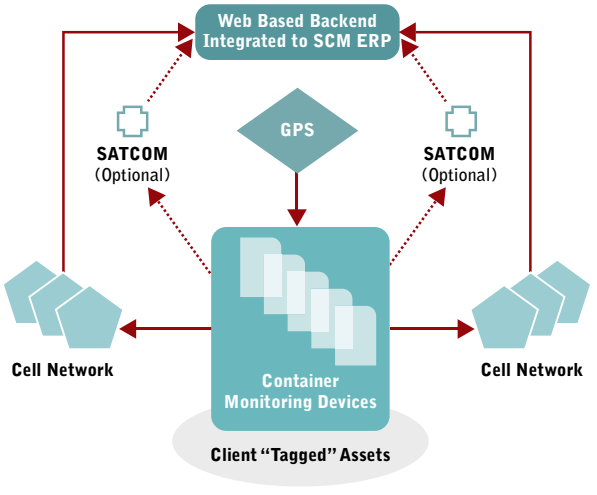
A CMD solution consists of two components (Exhibit 1.) The first is GPS/cellular tracking and sensing devices. They provide a system for the efficient collection of precise information about the physical operations of the in-transit supply chain. When these systems are also combined with other AutoID technologies, extremely granular data can be collected about each pallet, case, and conveyance vehicle; each salable unit; every asset, key part, or component; and all personnel, including associates, drivers, operators, suppliers, distributors, and customers. This information is recordable, available, and accessible in real- or near real-time. Most importantly, this data provides information that is actionable in real-time to solve or mitigate a problem before it affects your customer service—and that is key in today's customer oriented markets.

This type of available granular, precise information recorded directly in and during supply chain operations activities has been demonstrated to deliver an average supply chain operations cost savings of 3 percent to 5 percent and inventory investment savings of 7 percent and more. When combined, these savings have reduced the Unit Cost Of Goods Sold by an average of 0.5 percent for the products that were analyzed.

In the business context, these issues do not merit the commitment of time or financial investment until an enterprise has evidence of the potential delivered value and the costs of its own response to the value of precise information. Should this information provide value to businesses, and if regulators can derive regulatory value from the same information, the opportunity result is that regulatory agencies can tap into this same information for which the busi-

EXHIBIT 1

CMD Solution Schematic



Source: McKinney/Radford

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nesses first have their own internal value proposition.

These types of beneficial results have been achieved in a number of independent trials by several different organizations, including several globally executed research and testing projects. Two were sponsored by the European Union's FP7 Research grants: Project SMART_CM Container Management (www.smart-cm.eu) and Project Integrity (www.isl.org/projects/integrity). Both of these projects were based on the collaboration of commercial, academic, and regulatory organizations.

In each of the EU-sponsored projects, a substantial number (75 to 100 or more) of international container shipments were monitored by CMD's/CSD's from the time the container was loaded and sealed until the time that the container was unsealed and unloaded—"from Stuffing to Stripping" in industry jargon.

Throughout the journey, the device reported to its home monitoring system on a regularly scheduled basis, as well as in real-time if there was an alert of any kind that indicated a change in the status of a shipment being tracked. The home system then parsed the data into the message format required by the collaborative data pool, known as "the Neutral Layer" in SMART_CM and as SICIS in Project INTEGRITY. These data pools were accessed by the participating Customs Agencies, which could download and analyze the security data that had been collected.

In these trials, only the security data about the "door opening" status was collected and analyzed, but the devices were also monitored for other cargo condition indicators, such as temperature changes, shocks and vibrations, or the presence of light inside the conveyance.

Additional trials conducted purely by commercial shippers in collaboration with several different CMD device and system providers produced results similar to the financial results already mentioned. At this time, while the service providers are experiencing some industry consolidation, there remain more than 50 commercial enterprises that have developed supply chain and asset monitoring capabilities based on this technology and solution architecture—*autonomous CMD sensor data collection, GPS location, cell network communications,* and *application business intelligence*—as described earlier.

In only the past eight years the industry has executed tens of thousands of monitoring transactions on thousands of shipments. The authors have personally participated in many of these transactions, including these representative trials:

- Monitoring 40 foot ISO container ocean shipment of produce from Morocco to the U.S., identifying carrier route deviations, delays, and Customs interventions.
- Monitoring intermodal shipments (truck, rail, and ocean) of beverage producers from Scotland to the U.S., when an alert from the CMD notified the owners that the container was opened in route and the cargo stolen, allowing immediate law enforcement intervention and rapid replenishment of the cargo, saving time and cost and providing route security planning data, with the net result of improved customer service.
- Monitoring the intermodal shipment of consumer products from a U.S. source to an Ecuadorian buyer, where the logistics service provider (LSP) deviated from planned transit routing, transit mode, and planned fees by diverting the container from vessel to rail while charging canal transit fee's to the buyer when no canal passage actually occurred.
- Identifying in-transit damage to cargo due to improper handling through real time tracking and analysis of incidents, spotlighting the incidence site, date, and custodian of the cargo, and resolving the claim as well as optimizing future cargo handling to mitigate the risk.
- Analyzing asset utilization through monitoring location and use, allowing the fleet owner to reduce fleet size, increase asset utilization, and optimize asset "positioning."
- Identification of route delays that impeded fulfillment of 'just-in-time' inventory delivery and enabled the customer to optimize routing to alleviate delay incidence.
- Deployment of a CMD solution that monitored product integrity, allowing the shipper to secure contracts for supplying certified safe products.

The observed benefits are explained below.

Virtualization of Physical Product

GPS-based CMDs, RFID, and sequential bar codes make it possible through virtualization to uniquely identify and represent electronically each object—items, assets, and conveyances—that must be handled in business operations. This process of virtualization had already occurred for information (EDI) and for cash (EFT); now the entire set of supply chain flows—goods, cash, and data—can be tracked, the actual history recorded, and the entire operation modeled at any level of detail found to be useful by the enterprise (Exhibit 2.). This brings a new level of precision to real-time operations and operations planning that was not formerly possible.

The various forms of Auto-Identification Technology (AIT) extend the object information vector through the transportation process and allow total information availability about items as well as their location and their condition at all stages in their shipping cycle, no matter what the mode of shipment and transportation.

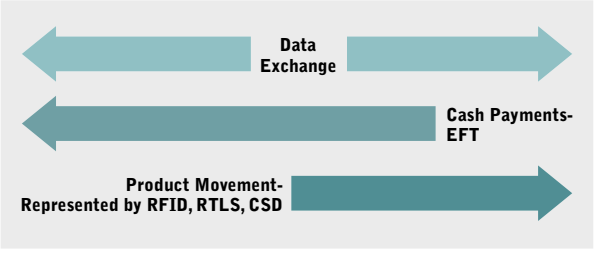
The various AutoID technologies each have particular strengths. For example, Real Time Locating Services (RTLS) or RFID are most effective within closed spaces, such as inside a facility or a container yard. GPS-enabled CMD's are best utilized for either unconstrained geographies or when real-time or near real-time alerts are required.

The logic is rather straightforward. The Container Monitoring Devices provide data and information about the portion of normal corporate operations that until now has provided very little information about its actual activities.

EXHIBIT 2

Value Delivery: Operations Virtualization

- Operations virtualization has now enabled electronic representation of all flows in the supply chain: The Virtualized Enterprise
- First there were electronic data transfers: EDI
- Then there was electronic money: EFT
- And now an electronic representation of physical product: AIT



Source: McKinney/Radford

This lack of real-time visibility and monitoring (supervision) has hidden real everyday costs from commercial enterprises.

According to some authorities, fully 85 percent of the shrinkage that occurs in the overall supply chain occurs while materials, components, or finished goods are in-transit from one location to another. Some of that is the result of the occasional theft. However, there are also various environmental operational damages, such as the damage that occurs through handling errors and changes in temperature.

Insurance can cover the financial loss—but not the customer service damage from missing product. Most businesses would simply rather have good product arrive as ordered and as promised, rather than go through the process and expense of explaining an issue to a customer, filing a claim, and then wrestling with the shipper, the transportation companies, or insurance company,

Methodology

Based on experience and lessons learned, the authors conducted multiple cost-benefit analyses of customers' supply chain processes and operations. We identified critical cost drivers, such as labor, time, process fees by LSP's, interest expense, and safety stock holding costs; the customers identified probable savings of deploying a CMD solution, codified in the following six steps in Exhibit 3.

In close collaboration with the clients' supply chain staff and vendors, the authors developed a financial model of all of the costs associated with a single supply chain transaction, from order placement to receipt at the destination distribution center, including internal and vendor fee costs. These external costs of Supply Chain Shipping Operations are only 60 percent of the total incurred expenses due to operating a supply chain capability.

The key to fully costing the transaction was to determine the internal corporate activity costs (labor, facilities, materials, interest) of an importer or buyer. Often overlooked in previous analyses, these internal costs constituted approximately 40 percent of the actual total landed costs of a trade transaction and were the key to identifying savings. Recognizing that LSP, insurance, terminal, and other "vendor" costs were market driven, the authors identified many hidden, overlooked, or unacknowledged costs that added 30 percent to 40 percent to the actual cash expenses of a trade. These become subject to process refinement based on deploying a CMD solution that provided physical and logical visibility into the process and actions of a trade.

The diagram, Exhibit 4, illustrates the sources and basis of the costs analyzed.

By fully acknowledging both the external and the internal operational costs of operating a supply chain, and by using the newly available data that CMD Systems provide while cargo is "in-transit," commercial clients achieved surprisingly robust financial results. In actual field trials with commercial clients, the availability of precise information directly from supply chain operations activities was demonstrated to deliver an average supply chain operations cost savings of 3 percent to 5 percent and inventory investment savings of 7 percent and more.

When combined, these savings reduced the Unit Cost Of Goods Sold by an average of 0.5 percent for the products that were analyzed, without affecting physical materials, production, or marketing costs.

Expense reductions were also directly observed in the following:

1. Reduced labor costs, derived by automating the actual tracking function, allowing the analysts to manage by exception, reducing the number of FTE's involved in monitoring each shipment.

2. Reduced safety stock costs derived from improved physical and logical visibility mitigation of "stock-outs," hence reduced unexplained variances.

3. Reduced shipment financing costs (interest expense) derived from reducing the duration of individual shipments (an example of typical "low-hanging fruit" types of savings).

4. Reduced vessel operations costs and incidence of "supplemental charges" and demurrage fees (due to the newly available precise information on routing and location).

5. Reduced shrinkage of all forms including theft, damage, and delay.

6. Additional savings that were indicated in these studies as potential for the future, but which were not observed directly:

EXHIBIT 3

A Six Step Process to Estimate the Value to be Achieved by Deploying a Container Monitoring Solution

1. Understanding Current Trade Processes
- On Site Workshop and "Discovery" Sessions
- Process "Walkthroughs"
- Process Mapping

2. Determine Organization's Trade Requirements
- Identify Strategic, Operational and Financial Trade Issues
- Identify Trade Constraints
- Analyze Critical Trade Processes

3. Map Container Monitoring Solution Features to Requirements and Trade Process Constraints
- Trade Management
- LSP Operations
- Process Constraints
- Financial Performance

4. Develop AS IS and TO BE Costs to Estimate Financial Benefits of Deployment
- AS IS Estimate
- TO BE Estimate
- Calculate Changes/Benefits

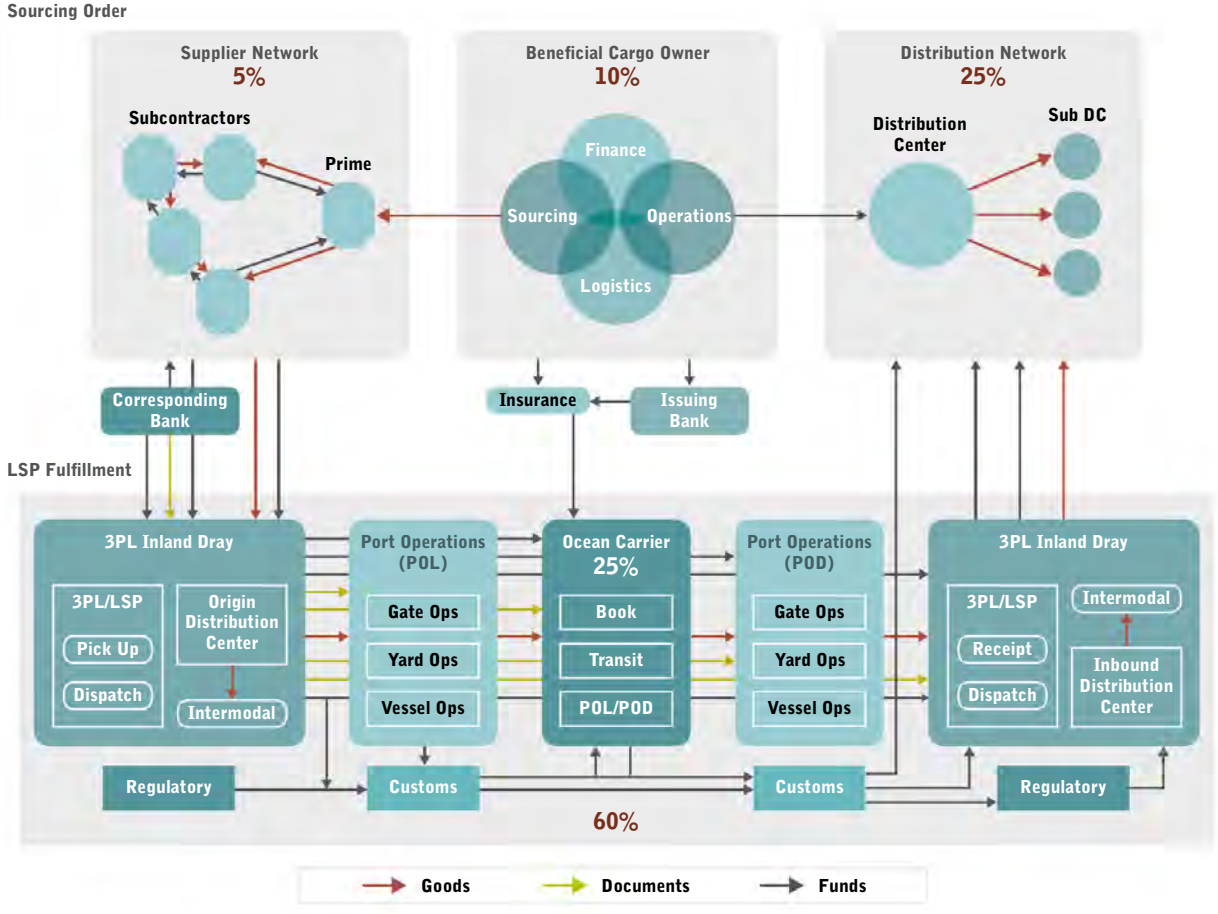
5. Develop Comparative Analysis
- Map Financial and Operational Benefits to Trade Management Processes
- Identify CMD Solution Impacts

6. Prepare Findings and Recommendations
- Trade Management Strategy
- Operational Improvement Opportunities
- Financial Performance

Source: McKinney/Radford

EXHIBIT 4

Trade Life Cycle Costs: 60% Supply Chain Operations, 40% Other



Clockwise from Top Middle: A consignee places a purchase order, initiating a series of complex financial and physical transactions, dependent on multiple participants, systems, coordination, trust, and performance.

Source: McKinney/Radford

a. reduced insurance claims costs, and
b. reduced transaction processing costs.

Observed inventory management cost savings were derived from the impact of using data and information to improve the consistency and measurability of actual in-transit supply chain operational performance. This enables lowering the statistical variances in actual performance, which previously have been tolerated as reality because there was no observable real-time in-transit measurement of the actual events, delays, routings, and cargo environmental conditions. The combined impact has been higher safety stock, higher cycle stock, and "just-in-case" stock.

The detailed data provided by the CMDs has been observed to enable:

1. Reduced on-hand inventory, attributed to increased physical and logical visibility, which reduces the risks of shipping and the associated costs of:
   a. product,
   b. financing, and
   c. handling.
2. Reduced warehousing costs (less stock = less space required).
3. Reduced inventory financing costs (visibility enables better management enables faster turns, lower holding times, and their associated costs).

Unquantified savings (savings not yet quantified by real world data) that should be cited are:

1. Brand Protection and the incidence adverse cost impacts of recalls and "sourcing" identification, such as recent spinach, pepper, and lead-paint incidents.
2. Supply chain process improvements attributable to visibility and the elimination of supply chain constraints that are in place without in-transit visibility.
3. Improved supplier performance by product sources and logistics service providers that a shipper will receive by leveraging in-transit physical and logical visibility, including the in-transit real-time shipment data that a CMD (CSD) senses and reports.
4. Reduced product damage costs derived from using the physical and logical data of shipments to identify both the causes and the occurrence locations of damages.

Expanding the Deployment of Cargo Tracking Technologies

Commercial enterprises will become convinced over time that filling the current supply chain in-transit information void with real-time monitoring data can lower their costs, in the same way that detailed demand side data from point-of-sale (POS) terminals has vastly expanded the knowledge of demand patterns.

This newly available, precise information about the conditions and events that are unseen by the stakeholders at either end of the shipment represents fertile ground for many operational and relational improvements in business, while also providing a few crucial pieces of data to regulators that are responsible for the security of all.

Exhibit 5 illustrates our forecast of the progression of value that will be derived from this newly available in-transit supply chain data and the potential applications, first to supply chain operations management, and over the longer term to corporate supply chain strategies.

As the technologies of CMDs, remote sensors, and wireless communications continuously improve in functionality and decrease in both cost and physical size, the commercial value will be proven by an increasing number of trading partners. The commercial value of the granular data will mature in a manner parallel to the maturation of POS terminals as they replaced cash registers. Forty years ago, some retailers actually declared that POS terminals were too expensive and the data was not worth the cost. Many of these retailers no longer exist. That is a lesson that should be heeded by supply side managers today.

EXHIBIT 5

What Can Real-Time In-Transit Visibility Really Deliver?

Starting Point: Occasional Data and Anecdotal Events	Consumer Demand: POS with Item Scanning	Supplier Performance: Real-Time ITV
Data	I. SKU Level Data	I. New data about dwell times, cargo conditions, security
Information	II. Store-Level Item Sales and Inventories	II. Deep factual granularity about actual field conditions
Knowledge	III. Trends/Replenishment	III. Yields operational tactical improvements
Wisdom	IV. Merchandising Direction	IV. And new management insights and direction
Vision	V. Consumer Lifestyles Reveal New Services	V. Which create new long-term supply chain agility strategies

Source: McKinney/Radford

Acknowledgement:

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Solving the *Reshoring Dilemma*

By Patrick Van den Bossche, Pramod Gupta, Hector Gutierrez, and Aakash Gupta

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A number of events have tipped the balance in favor of domestic manufacturing, leading to a growing reshoring movement in the U.S. Still, bringing manufacturing back isn't for everyone. Here are some of the tools and factors you should consider to assess whether reshoring is right for your company.

It's not news that manufacturing in the U.S. has become more attractive in the past few years. And, even though there is no torrent of renewed manufacturing activity moving the needle just yet, it's clear that the reshoring movement is growing. At the very least, it should make U.S. companies think twice about where they will manufacture their products in the next few years. But how do you figure out whether to jump on the reshoring bandwagon or sit this one out? There are a few tools and tests that can help you assess whether reshoring is the right choice. And if the answer is "Yes," making sure your assumptions are realistic and you are factoring in all the moving pieces into your analysis is crucial to avoid any nasty surprises.

A number of macroeconomic factors have tipped the balance in favor of domestic manufacturing, at least for some industry sectors. Among them are the appreciation of China's currency versus western currencies, China's labor rate inflation, increased concerns about supply interruption, lower energy costs in the United States as a result of shale gas exploration, and a general push from federal and state governments to reduce the costs and administrative barriers of bringing manufacturing back.

Companies are responding: A growing number of reshoring cases, ranging from heavy machinery and appliances to chemicals, have been covered by the media in the past few months. Several recent studies have added even more fuel to the fire by identifying a number of industry sectors that, based on macroeconomic factors and industry cost models, should consider reshoring their operations. The usual suspects include computers and electronics, appliances and electrical equipment, primary metals, machinery, furniture, plastics and rubber, paper, and fabricated metals.

A list of recent reshoring cases published by The Reshoring Initiative* shows many of these industries indeed at the forefront. If you are active in these industries, reshoring should be on your radar screen. There are, however, cases from less straightforward industries, such as that of an Indian textile

Recent Reshoring Cases

Electrical Equipment, Appliance, and Component Manufacturing	Number of cases: 33	22%
Transportation Equipment Manufacturing	24	16%
Computer and Electronic Product Manufacturing	17	11%
Plastics and Rubber Products Manufacturing	13	8%
Fabricated Metal Product Manufacturing	10	7%
Machinery Manufacturing	10	7%
Apparel Manufacturing	7	5%
Furniture and Related Product Manufacturing	7	5%
Chemical Manufacturing	5	3%
Food Manufacturing	4	3%
Other Manufacturing	12	8%
Other Non-Manufacturing	10	7%

Source: Reshoring Initiative

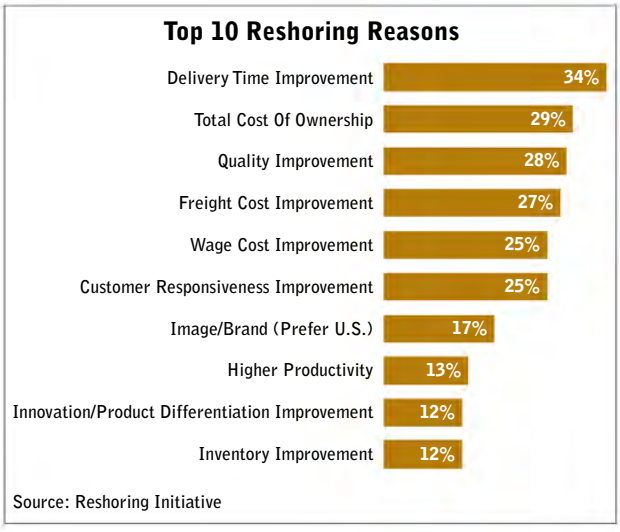
company that recently set up manufacturing operations in the U.S. The move placed the company closer to raw materials (cotton, for example) and also helped position it to take advantage of Wal-Mart's promise to source an extra $50 billion of domestic products over the next decade. Of all the industries, textiles would be one of the last you would expect to return to the U.S. if only the macroeconomic picture was considered. On the other end of the spectrum, several companies in slam-dunk industries aren't planning on returning anytime soon. So only taking into account the macroeconomic factors does not provide the complete answer.

What Drives Companies to Reshore?

What's more interesting is that when asked why they decided to reshore their operations, the companies on the list cite a variety of reasons. (See chart on following page.)

Several of these reasons are linked to being closer to the customer. It's important to remember, however, that the location of your suppliers is a crucial factor in realizing these benefits. Unfortunately, most domestic supplier networks have evaporated or followed their customers overseas. Because there's typically a delay of a few years between companies moving and their supply base following them, companies that return their own manufacturing operations may still have to rely on suppliers from overseas, at least until the economics for the supplier also drive them to return to the U.S.

This would of course diminish the proximity-related



benefits of reshoring because the end-to-end supply chain could still be as long as before and therefore prone to disruptions. As a result, manufacturers may now have to stock up on supplies or parts instead of on finished goods, as was the case when they had their own manufacturing operations overseas. This would mean less money tied up in inventory (parts have less value than finished goods), but it would still require approximately the same amount of storage space, albeit more concentrated near plants than finished goods inventory, which is typically stored closer to points of sale.

As suppliers start to move back, several supply chain and logistics changes would take place that would affect cost and service. You would see much less container traffic to the West Coast ports and therefore less need for intermodal transport to deliver those containers from West to East. Because it appears the non-union states in the South may be attracting much of the returning manufacturing operations, you could anticipate a shift in goods flow to more of a south-to-north pattern, which has already started to emerge due to the rise of manufacturing in Mexico. This will require logistics services companies to adapt their networks and fleets, and the availability of warehousing space and transportation will depend on the pace with which that happens. So the expected cost, inventory, and even service benefits related to becoming "local" again are far from guaranteed.

Similarly, the cost-related reasons are not that straightforward, as many of the forces that drive the reshoring cost equation are very much still in flux, such as the labor cost gap and the energy cost differential between the U.S. and Asia. It's true that in China labor costs are projected to rise six-fold from 2004 to 2016 (The Economist Intelligence Unit wages time series). However, labor costs in the U.S. are also creeping up. Manufacturing labor is becoming scarce due to a higher retirement rate than graduation rate and an overall lack of skilled workers. The past years' wage inflation of nearly 2 percent is forecasted to continue (*Reuters*, "U.S. labor costs rise, point to more steady inflation").

In addition to labor costs, the positive outlook for U.S. energy also makes the case for reshoring look attractive. The relative success of American fracking initiatives is expected to keep U.S. electricity costs 40 percent to 70 percent lower than in Europe or Japan. However, the longevity of the many fracking wells is in question. According to DrillingInfo, an international oil and gas intelligence company that tracks the performance of U.S. wells, the production of wells bored into so-called tight oil formations has typically declined by 60 to 70 percent in the first year alone. And the U.S. isn't the only country that has shale gas; other regions of the world are also sitting on sizeable reserves. China has even greater reserves than the U.S., but they are more difficult to access (*The New American*, "United States to Become the World's Primary Energy Producer in Four Years"). However, once these reserves are successfully tapped, China's yearly electricity price growth, which currently sits around 8 percent, will slow down and prices may even decrease (Enerdata China Prices time series). It is therefore unclear if the U.S. will be able to rely on shale gas as a sustainable energy cost advantage.

Finally, the impact of brand improvement is predicated on the fact that the "Made in America" designation is making a comeback. But what remains to be determined is the size of the price premium that consumers are willing to pay; this has largely been untested. Companies that make sensitive goods, such as baby food, can claim that by being U.S.-based, they are safer and better regulated than ever and that justifies a higher price. But as many companies found out as they signed on to the green movement, there's only so much that consumers are willing to spend on goods that match their values and world views. Especially in more commoditized industries, the quality and brand proposition of "Made in America" does not necessarily have the same uplifting effect on price. Similarly, in highly competitive industries, the price premium diminishes as well.

After looking at the reasons that drive companies to reshore, it's not clear how robust the business case is. As a result, the decision to reshore should not be taken lightly.

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case (see Exhibit 1). However, rather than diving into a location search immediately, it's important to answer three questions, in the following order:

1. Is my reshoring decision future-proof?
2. Is my company ready to reshore?
3. Where is the best reshoring location?

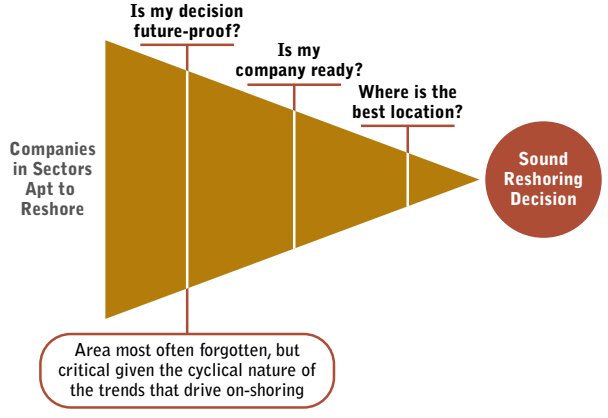
Is My Reshoring Decision Future-proof?

When considering whether reshoring is right for your company, it's important to remember that the answer isn't a simple yes or no, but rather a more qualified answer, such as: "Yes, but only under conditions X and Y."

Understanding these conditions requires thinking through potential scenarios (see Exhibit 2). The tried and tested methods of scenario planning can help you find the right balance of testing for operational efficiency and robustness by determining the potential impact of

EXHIBIT 1

Reshoring Decision Funnel



Source: A.T. Kearney

macroeconomic and industry trends on different reshoring options in an unbiased way. The process can help test alternative future scenarios, such as energy cost differential and supplier network developments, and include them during the development of the reshoring solution to ensure that your company has the right balance of steady state efficiency and future-proof robustness. It can also help identify potential areas of weakness and the risk mitigation plans to overcome them.

In a typical scenario planning exercise, alternative futures or scenarios are developed by generating interactions between the macroeconomic environment and the industry environment. The first step involves determining the timeline that you need to consider to make sure the cost and capital related to reshoring are adequately paid back. Given that timeline, you then need to determine the set of macroeconomic and industry trends that can drive change in your business to the extent that it could impact your reshoring decision. The list of trends or business drivers obviously depends on the business environment that your company competes in but, regardless of industry, these exercises usually result in a healthy list of 10 to 15 factors that could affect the reshoring dilemma.

In the somewhat simplified and more practical approach that we would recommend to find the right reshoring answer, the second step involves selecting the top two drivers that could shape a company's performance and articulate the polarized outcomes for these drivers. For example, if energy costs are indeed one of the top two variables that will affect the reshoring decision for your company or industry, the two polarized outcomes could be "Energy Costs Stay Low" within the chosen timeline or "Energy Costs Revert to Pre-Shale Gas Levels." Once the two ends of the spectrum are articulated for each of the top drivers, a 2 x 2 grid of plausible and relevant futures, or scenarios, can be created.

Once the four scenarios are laid out, the reshoring evaluation team needs to determine the expected probability for each future scenario relative to the others and figure out how the business case to reshore is affected by each scenario. This approach provides a stress test by comparing the results and developing a transparent analysis that indicates whether the decision to reshore is future-proof. The reshoring evaluation team can then easily share its findings to stakeholders, refine as necessary, and move on to the next step.

EXHIBIT 2

Scenario Planning–Macro and Industry Trends

Source: A.T. Kearney

Is My Company Ready to Reshore?

While the macroeconomic math can provide directional confirmation that the environment is ripe for you to consider reshoring, several internal factors, specific to each company, will have to be further investigated before announcing any strategic reshoring move publicly. For example, the fundamental macroeconomic drivers of the chemical sector—high energy consumption, proximity to the supply base, significant domestic demand, low level of manual labor needs—create a good high-level business case and probably prompt many companies in this space to consider reshoring to the U.S. However, the actual attractiveness of setting up a new manufacturing operation stateside can vary significantly from company to company.

For example, available capacity is one of the more important factors to consider when assessing reshoring attractiveness as it can provide multiple economies of scale and scope while accelerating the operation's transition and learning curve. So, if a company determines that they can make enough existing capacity available—by adding shifts or by restarting a mothballed operation—to meet the needs of its business, they can avoid the significant capital investment that's required to build new operations. However, even though the short-term savings and benefits that reshoring to existing sites provides are substantial, companies could be missing out on long-term savings or advantages that other manufacturing-hungry destinations and their governments may offer.

When locations with free capacity are available, however, the (psychological) pull to reshore into those locations is usually pretty strong. Our research of companies that have reshored found that 74 percent of companies reshored to existing locations. These companies mentioned existing capacity, supply chain ecosystem synergies, and favorable labor relations as their top considerations.

Companies that believe they may benefit from reshoring but don't have available capacity or optimal locations in the U.S. need to make a key decision about whether to own or outsource the reshored operation and all its transition needs. This "make or buy" decision should obviously fit into the broader business and manufacturing strategy and should consider both internal and external aspects, such as a company's ability to run the operation in a cost-effective way, and the competitive landscape and evolving ecosystem around it. Other factors that may impact the best ownership scenario for the reshored operation include intellectual property concerns, need for direct control over the operation, total volume, and redundancy considerations.

Once availability of internal capacity or the right ownership model for new capacity is established, different internal capabilities must be assessed and, if needed, the cost associated with any required improvements should be included in the reshoring business case. Creating an objective view of your capabilities, acknowledging any systemic flaws, and working ahead to fix them (or ignore them) could mean the difference between a successful and a failed reshoring effort. Readiness factors must be weighed and evaluated rigorously in order to determine if reshoring is the right decision for the company. These factors include practical considerations that will also play a role in the successful execution of the reshoring effort, such as a company's capability in the area of technical expertise, experience in building greenfield sites and in ramping-up the new reshored operation, and experience in managing large projects effectively. Examples of reshoring readiness factors and typical upgrade decisions as used by some of our clients are shown in the table on the next page.

Skills availability, in particular, has become an area of concern as long-term demographic trends continue to play out. As a result of years of widespread offshoring, the skilled trades—such as electricians, advanced machinery operators, and plumbers—have become the most in-demand segment of the U.S. workforce. Across industries, more than three out of four manufacturers reported they have a need to fill certain skill gaps over the next 12 to 24 months (*The Global Manufacturer*, "The Critical Shortage Facing U.S. Manufacturers"). Furthermore, skilled tradesmen are much older than the average workforce—53 percent are 45+ compared to 44 percent in the overall workforce—and many are nearing retirement. In particular, more than 25 percent of electricians and electrical engineers, extruding and drawing machine setters, stationary engineers and boiler operators, machinery maintenance workers, and computer-controlled machine toolers are already 55+ (*Forbes*, "America's Skilled Trades Dilemma: Shortages Loom as Most-In-Demand Group of Workers Ages"). To make the perfect storm complete, young Americans have gradually moved away from manufacturing and STEM-type classes due to the perceived lack of opportunity, and community colleges, technical schools, and apprenticeship

Reshoring Readiness Factors

Capability	Description	Decision
Skills Availability	Degree of functional expertise of current workforce	If capability not at par, consider relocation of experts or local acquisition of capability
Asset Health and Performance	Age and health of machinery, OEE performance	If not in good health or performance, include capability enhancement in business case
Knowledge Transfer	Existing processes and infrastructure to transfer knowledge and experts	If process or infrastructure not in place, include capability enhancement and ramp-up in business case
Project Management	Internal capability to run high stakes projects effectively	If capability not up to task, include capability enhancement or external support in business case

Source: A.T. Kearney

programs have followed suit and cut back on those programs. Even if we started today with seriously rebuilding a manufacturing education curriculum, it would take at least a decade for the effects to show. It's not just that the students aren't there; the teachers have left, too, either to retirement or to more lucrative industries. As a result, the skills availability problem will only grow more acute over time.

Not being able to find skilled resources that could be plugged in immediately may not be that big of a deal—if solid training programs were available. Unfortunately, training was often a casualty during down times as companies looked to cut costs. A building block that's crucial to any effort to teach freshly minted graduates how to function in a manufacturing environment is standard operating procedures (SOPs). SOPs are in place at almost all manufacturing plants, but they're most likely outdated as they relate to operations that were sent overseas. Operating guidelines and procedures that are often 15 years out of date will not help a person straight out of school get up to speed quickly, but given the state of the workforce, SOPs are a crucial piece to solving the reshoring puzzle. As older generations who have a wealth of experience and knowledge retire, it's especially important that SOPs are documented as it will help educate new employees. Recreating SOPs (or keeping them up-to-date), using apprenticeship models to orient new hires, or having new employees shadow others on the job are all potential ways to deal with the skill shortage, but they all come at a cost that needs to be factored into the reshoring business case. A company must therefore anticipate the skills shortage by taking an honest assessment of its workforce readiness and the potential fixes (such as training and SOPs) and developing plans to leverage its existing workforce to the maximum extent possible.

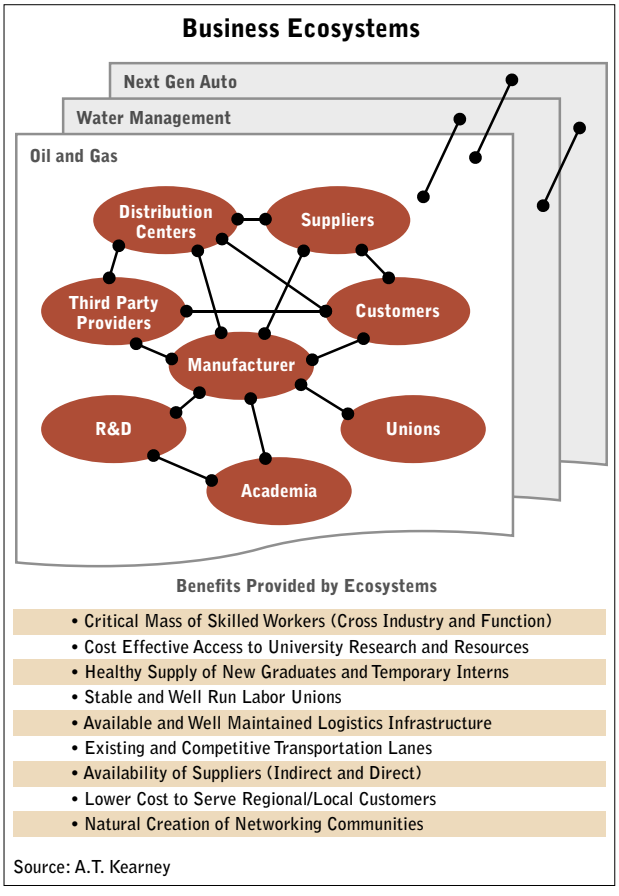
For some reshoring readiness factors, the evaluation may be largely qualitative. However, it will help identify the key decision drivers and some of the potential pain points a company may face during implementation, and provide an understanding of where the reshoring business case stands. As a result, the evaluation will deliver sufficient confirmation to go ahead with the strategic decision to reshore manufacturing to the U.S. If the evaluation is positive and a new location is required, the next step is to find the best reshoring location.

What is the Best Reshoring Location?

A thorough location selection exercise must be conducted, including an evaluation of quantitative cost measures and qualitative capability assessments. The evaluation of these location selection factors includes defining the right factors, setting a specific weight to each factor, and rating the performance of each factor for each of the selected locations (cities or states). This is commonly conducted by a multifunctional committee in order to bring different points of view while maintaining the transparency and objectivity of the exercise. Examples of location selection factors used by some of our clients are shown on the following page.

The location selection factors mentioned above provide a good template to compare and shortlist potential reshoring locations. As previously discussed, labor availability is an operating risk that companies should be particularly sensitive to. In fact, our research of companies that have reshored found that 26 percent of companies that moved to new locations picked those locations based primarily on advantaged skilled labor, supply chain ecosystem synergies, and proximity to customers.

Skilled labor and customer proximity are obvious in that equation. However, factors such as the economies of scope and network externalities that existing business ecosystems provide are often hard to measure independently. What is the value of established universities or trade schools that provide research and new talent? What is the value that established supply chains of different industry sectors can provide to your company? What is the value an established and thriving community can provide to your employees? As it turns out, rich and diverse business ecosystems can provide positive linkages within and across industry sectors at all levels of an organization (see Figure 3). Business ecosys-



tems are especially valuable for companies considering a greenfield reshoring operation as they could provide a shortcut to build capabilities while lowering startup and ongoing costs. Indeed, they help address the shortage of labor by providing a critical mass of workers for a variety of key needs. Nearby universities can also provide high-potential, local labor that comes without the often sizeable relocation fees.

Choosing the reshoring location is one of the most critical decisions, not only for the reshoring company but also for the potential destination locations. State economic development programs have acknowledged the reshoring trend and the economic benefits that come with it, and are actively benchmarking and improving their offerings to attract operations that are being reshored. A best practice in determining the right location to reshore is to understand the perspective of the potential host locations by engaging and collaborating with them to find the best reshoring scenario for both sides. It may be useful to know some of the key considerations that host destinations take into account as they determine how to "sweeten the pie" during reshoring negotiations:

- Is this company in a strategic sector for our state?
- Does this company have critical mass to create an economic impact immediately? In the future?
- Does this company have a sound business plan?
- Does this company already have an operation in our state?
- Can this company leverage the infrastructure investments we've made in our state?
- Can this company leverage the workforce training programs we've set up in our state?
- Would this company operate within the boundaries of current regulation?

During this collaboration it's important to understand where your company ranks on a state's attractiveness index and also be transparent in what your key decision drivers will be in order to find the sweet spot for both partners. Also, when defining the right reshoring location, it's important to keep in mind that what is right today may not be right tomorrow. Using the scenarios defined as part of the exercise to determine whether your reshoring decision is future-proof (see above) and looking at the potential locations through the lens of each of these scenarios is a good practice to ensure that the reshoring location decision holds in the future.

Not Straightforward

The equation to determine whether reshoring is right for you, both now and in the foreseeable future, is probably a bit more complicated than you had envisioned. But that's not necessarily a bad thing, as the process may help you avoid making decisions that you could live to regret. Multiple pitfalls and headwinds can negatively affect the timing, effort required, and even the business case at the root of your reshoring project. To do reshoring the right way, companies must understand the underlying conditions that drive the attractiveness of reshoring for their company. Knowing that your company's overseas operations are good candidates for reshoring, even under multiple future scenarios, is only half the task. Testing your readiness and deciding who should own the operation and where the best reshoring location should be is equally important. Only by going through a rigorous analysis and process will companies know if reshoring is the right decision for them, both now and in the future.

***Editor's Note:** The Reshoring Initiative is an industry-led effort to bring manufacturing jobs back to the United States. The initiative works with U.S. manufacturers to help them recognize their profit potential as well as the critical role they play in strengthening the economy by utilizing local sourcing and production. Among the tools and resources available from the initiative are a Total Cost Of Ownership estimator. For more information on this program, visit www.reshorenow.org.*

Understanding Supply

Resilience is at the heart of current supply chain management thinking. Understanding the concept, and where to invest in resilience, can lead to supply chains that quickly respond to and recover from costly disruptions.

By Steven A. Melnyk, David J. Closs, Stanley E. Griffis, Christopher W. Zobel, and John R. Macdonald

When Boeing announced plans to assemble the 787 Dreamliner in late 2003, it introduced a new concept to the assembly of a commercial aircraft. Instead of building the plane from the ground up, subcontractors from around the globe would deliver completed subassemblies to Boeing's factory in Everett, Wash. for final assembly. While the approach was intended to create a leaner manufacturing process, development of the new aircraft was beset by numerous supply chain related disruptions—events that interrupt the flow of products and information between raw materials, production, and the end customer.

One of those disruptions occurred just last January

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Chain Resilience

2013, when the Dreamliner was grounded by the FAA due to overheating of its new lithium-ion battery. As a result, Boeing needed to slow production of this innovative aircraft until it determined the source of the overheating—a source that appeared to lie within in its supply chain, according to news reports. The question for Boeing was how quickly it could identify the source of the overheating and recover from the disruption.

At bottom, that was a question of how resilient the Dreamliner supply chain was. Boeing is not alone. In today's increasingly dynamic and turbulent world, one where the supply chain plays an increasingly more important role, numerous events occur each day that threaten to disrupt operations and jeopardize the ability to perform effectively and efficiently. These events include natural and man-made disasters such as equipment failures, fires, labor disputes, supplier defaults, political instability, and terrorist attacks. Each can have devastating effects on a firm. Such disruptions reinforce the insights that not only can supply chain disruptions affect operations; they often result in financial damage well beyond the immediate operational impacts.

One approach to dealing with disruptions is the development of supply chain systems that are resilient. However, this notion of resilience, which is at the heart of so much of our current thinking about supply chain risk and management, is often not well-defined and subject to a great deal of confusion.

While many consultants, researchers, and managers agree on the importance of supply chain resilience, there is less agreement on what it is, how it operates, and how and where to invest to mitigate risk and recover from disruptions—to shape and influence resiliency. This article draws on the expertise of the authors, prior research, anecdotes, and recent events to define and further explore this concept.

Specifically, we propose that resilience happens by design and not by accident. The resilient supply chain requires two critical capacities : the capacity for resistance and the capacity for recovery. The first, resistance, defines the supply chain's ability to delay a disruption and reduce the impact once the disruption occurs. The second, recovery, defines the supply chain's ability to recover from a disruption.

The remainder of the article identifies and discusses the tradeoffs between these two resilience capacities, how each responds to issues of supply chain uncertainty and risk, and investments that firms can make to enhance supply chain resilience capabilities. The conclusion: Resilience is a capability that must fit the specific needs of each firm.

Supply Chain Resilience Defined

The concept of resilience traces its roots back to the work of C.S. Holling, an ecologist who first noted the characteristics of a resilient ecological system in 1973. Since then, the notion of resilience has been applied to fields as diverse as psychology, systems thinking, disaster management, and more recently, supply chain management.

For some, resilience is a reactive capability that occurs after a disruption or shock has taken place. Others see resilience as more proactive efforts toward helping the firm prepare for a disruption. In light of these divergent observations, it is not surprising that there is confusion surrounding this key concept.

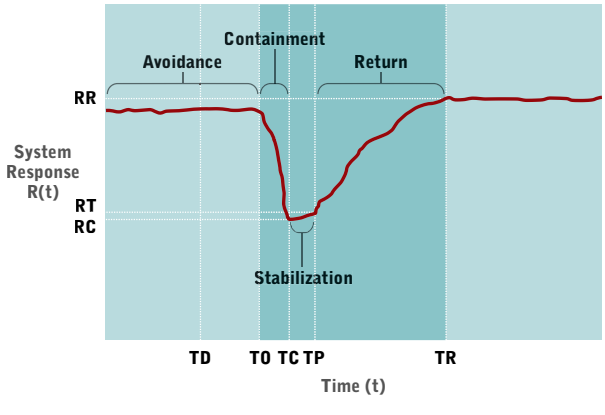
To the authors, supply chain resilience is "the ability of a supply chain to both resist disruptions and recover operational capability after disruptions occur." As mentioned above, viewed from this perspective, resilience consists of two critical but complementary system components: the capacity for resistance and the capacity for recovery. Let's look more closely at those elements:

- *Resistance capacity* is the ability of a system to minimize the impact of a disruption by evading it entirely (avoidance) or by minimizing the time between disruption onset and the start of recovery from that disruption (containment).
- *Recovery capacity* is the ability of a system to return to functionality once a disruption has occurred. The process of system recovery is characterized by a (hopefully brief) stabilization phase after which a return to a steady state of performance can be pursued. The final achieved steady-state performance may or may not reacquire original performance levels, and is dependent on many disruption and competitor factors.

Exhibit 1 portrays the impact of a disruption over time, from the moment that the disruption originates somewhere in the system (at time TD) until the system has returned to some form of steady-state (TR).

EXHIBIT 1

Time Series Display of Supply Chain Resilience Factors



Source: Michigan State University

In this illustration, we can identify the four stages of resilience, which are avoidance, containment, stabilization, and return. Exhibit 1 also defines the sequence of events, or time series signature, in a disruption as well as the typical system response for a typical disruption. Those would include inventory levels, cash flow, and asset availability to name just a few.

Two variables are central to understanding this illustration, T and R. T denotes the time at which a specific event occurs while R denotes the relative impact of the event as measured in terms of dollars, units lost, change in fill rate, or some other metric that is important to a firm's performance. Taken together, time (T) and response (R) are important because they define inflection points in the time series signature where a change in state can be observed.

The differences between the variance events listed in Exhibit 1 identify traits of interest to management. For example, TO-TD, or the gap between the moment at which the disruption took place (TD) and the moment that that disruption began to affect the firm (TO), tells management how long it will take for the firm's performance to be impacted; this time interval also identifies the maximum amount of early warning that the firm can count on to begin taking action to minimize the negative effects of the disruption.

When supply chain disruptions and their traits are observed, it is interesting to compare how the policies and strategies used by the firm can affect the various events identified in Exhibit 1 and Exhibit 2 in terms of both time and impact.

Once recovery is complete, firms often reflect upon their experience to document appropriate lessons and identify system refinements to reduce future risks. This completes a supply chain resilience cycle of: Avoidance → Containment → Stabilization → Return → Review → Avoidance.

Resistance and Recovery

To illustrate the concepts of resistance and recovery, consider the 2011 Japanese earthquake and subsequent tsunami. In the wake of these twin disasters, it quickly became apparent that suppliers for both Nissan and Toyota facilities lacked adequate resistance capabilities when faced with an event of this magnitude. Nissan, however, exhibited significant capacity for recovery. It resumed operations and regained lost market share more quickly than Toyota. Nissan was able to achieve this by

EXHIBIT 2

Description of Time Series Inflection Points

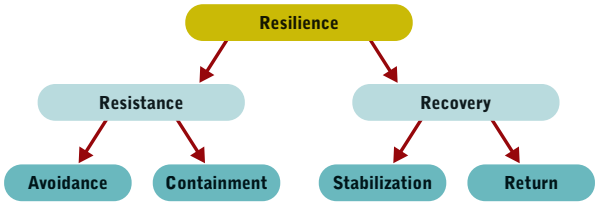
Event	Type	Full Name	Operational Definition
TD	T-Time	Time of Disturbance	Specific time period in which the triggering event is initiated.
TO	T	Time of Onset	The time period in which the system being studied feels the impact of the triggering event.
TC	T	Time of Climax	Time period in which the system reaches its climax.
RC	R-Response	Response at Climax	The system response at the climax.
TP	T	Turning Point	The time period in which the system begins to recover from the disturbance.
RT	R	Response at Turning Point	The system response at the turning point; the response at which the system transitions from being impacted by the disturbance to recovering from the disturbance.
TR	T	Time of Recovery	The time period in which the system returns to steady-state.
RR	R	Response at Recovery	The system response level at the recovery period (may differ from the pre-disturbance response level).

accessing alternative suppliers, while Toyota stayed with existing suppliers. Nissan's supply chain thus provided a differential advantage over that of Toyota, despite their highly similar supply chain networks and locations relative to the earthquake/tsunami. Although full avoidance of a supply chain disruption is an admirable goal, accidents and disruptions will still occur. Instead, firms need to develop the ability to deal directly with events that are unavoidable.

Exhibit 3 below illustrates an alternate view of supply chain resilience, which characterizes resilience into the capacities for resistance and recovery along with the respective phases: avoidance, containment, stabilization, and return.

EXHIBIT 3

Tree of Supply Chain Resilience



Source: Michigan State University

While firms would clearly prefer to possess a high capacity for both resistance and recovery, it is more likely that firms will have a mix of these qualities. In particular, given resource constraints and competitive factors, firms may need to choose where it is best for them to invest limited resources. That is, the firm may not be able to afford to invest in both improving resistance and recovery. With this in mind, the resistance and recovery matrix (Exhibit 4) characterizes possible positions that a firm might find itself in with regard to varied levels of these attributes.

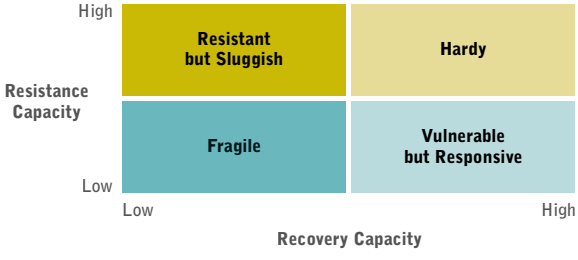
Supply chains exhibiting low capacities for both resistance and recovery would have low resistance: They would experience nearly every disruption while also having slow and weak recoveries as a result of a lack of ability to recover effectively. These supply chains are "fragile." Their long-term prognosis is very poor since they likely will not last and won't grow, unless protected by unique market or regulatory conditions. For example, some industries in Sri Lanka over the past decade have suffered multiple disruptions due to civil war, theft, power outages, monsoon rains, and flooding. Firms in these industries have survived, however, because effective competition does not exist or because competition chooses not to compete in such market or regulatory environments. As a result, fragile supply chains that provide poor quality customer service persist because the customer base is conditioned to accept low customer service.

In contrast to fragile supply chains with low resistance, those that exhibit high levels of resistance are able to alleviate potential risks more easily. When they also possess the capacity for effective recovery, they quickly rebound from those events that are unavoidable. Such supply chains are classified as "hardy."

General Motors (GM) is an example of a hardy supply chain. According to reports, GM constantly monitors its supply chain to minimize disruptions and, when necessary, to facilitate recovery. That was the case during the Thailand floods of 2011. Despite having plants

EXHIBIT 4

Resistance and Recovery Matrix



Source: Michigan State University

and suppliers in the area, GM experienced limited disruptions to the flow of materials because it was able to resist the onset of problems better than its competitors. When disruptions became unavoidable, GM was robust enough to quickly work through them and recover.

Somewhere between fragile and hardy there exists two middle positions. Supply chains that are characterized by an ability to adequately minimize disruptions, but an insufficient ability to quickly recover, are "resistant but sluggish." These supply chains exhibit high levels of resistance, but if the system is ultimately disrupted, the supply chain impacts are negative. These supply chains are like a heavyweight boxer who is able to take significant attacks, but who is knocked down for a significant amount of time if pushed too far.

The use of the term "sluggish" in this case does not imply ineptitude or lack of desire to restore operation, but rather insufficient capability to do so. This may arise, for example, from lack of recovery training as resources are focused toward resistance instead. The chemical industry is a case in point. Although these firms develop relatively strong defenses against a disruption, if a spill or other event occurs it may lead to serious consequences that built-in recovery capabilities might not be sufficient to address quickly due to the nature of such spills.

The full avoidance of a supply chain disruption is an admirable goal. However, accidents and disruptions will still occur. For that reason, firms need to develop the ability to deal directly with events that are unavoidable.

The other middle position is characterized by supply chains that exhibit low resistance to disruptive events, but quickly overcome their impact. These supply chains are termed "vulnerable but responsive." Similar to an electrical fuse in a building, these are easily knocked offline, but they have the capacity to quickly recover. An example of such a supply chain might be that of the clothing manufacturer/retailer Zara. The fashion industry is routinely beset by both supply and demand disruptions, but Zara (as well as some other manufacturers) has invested heavily in flexible manufacturing so that it can respond quickly to such changes. Recognizing that these demand disruptions are the nature of its market, Zara has invested in responsive systems to facilitate recovery.

While the "fragile" position is clearly undesirable and the "hardy" position the brass ring, the existence of the "middle" positions requires acknowledgement that firms may reside there for two reasons.

- First, there may be limited resources with which to invest in both capabilities.
- Second, there may be limited control over the environment in which a supply chain operates.

The different manifestations of this lack of control in a supply chain require firms to consider the notions of supply chain resilience, risk, and uncertainty.

Supply Chain Resilience, Risk, and Uncertainty

The distinctions between supply chain resilience, risk, and uncertainty are often blurred and unclear. Unfortunately this issue is exacerbated by the fact that some use risk and uncertainty interchangeably, implying that these two concepts are the same. Yet, this is not the case. While linked, they are separate and distinct concepts.

Risk exists so firms have to deal with the possibilities of encountering situations that can adversely affect them. However, not all future events are equally unknown. Past experience offers some insight regarding what events could occur, the probability of occurrence, and the impact. Firms can predict the likelihood of these events over a set time period to help them determine how to potentially react when they occur. Events with a greater likelihood and significant potential impact require greater preparation.

In contrast, uncertainty considers unpredictable events. Typically, these are events that have not been previously encountered. Alternatively, they are events where the type of event falls outside of past experience. To understand the differences, consider what happened at the Fukushima Daiichi nuclear plant following the Tohoku earthquake and tsunami.

This represented the largest nuclear disaster since the meltdown of the reactor in Chernobyl in 1986. It caused the evacuation of 100,000 people from their homes. When 11 of Japan's 50 nuclear reactors closed immediately following the earthquake, the capacity to produce electricity was reduced by some 40 percent. In addition, key air and seaports shut down, affecting the global supply of semiconductor equipment and materials for consumer electronics, as well as parts sourced in Japan for the wings, landing gear, and other major systems for Boeing's 787 Dreamliner.

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Author

Mitch Albom
Author of The Time Keeper, Tuesdays with Morrie and The Five People You Meet in Heaven, columnist, and broadcaster

Sucharita Mulpuru-Kodali
Vice President, Principal Analyst
Forrester Research

Also participate in panel sessions that include the following retail executives:

Pete Capel
Vice President, Merchandising
The Home Depot, Inc.

Mark Hilborn
Senior Vice President, Supply Chain
PETCO Animal Supplies, Inc.

Rick Keyes
Executive Vice President, Supply Chain Operations & Manufacturing
Meijer, Inc.

Ron Link
Senior Vice President, Logistics
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Bob Lowe
Vice President, Trade Operations & Customer Services
Nestle Waters

Mike Robbins
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Target Corporation

Laura Wilkin
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Wal-Mart Stores, Inc.

June Young
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CVS Caremark Corporation

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EXHIBIT 5

Eight Categories of Resilience Oriented Investments

Investment Strategies	Investment Strategies Summarized	Examples of Investments
1 **Discovery**	Investing in the ability of the firm to identify potential problems in the supply chain as close to the event occurrence as possible.	• Improved Information Technology or Information Sharing • Early Warning by Supply Chain Partners • Forecasting • Demand Sensing • Monitoring of Performance in the Supply Chain
2 **Information**	Investments in improving the quantity, speed, and quality of information flowing within the supply chain.	• Improved Information Technology • Effective Communication • Information Visibility
3 **Supply Chain Design**	Designing and implementing supply chains that can be configured and reconfigured quickly in response to environmental changes.	• Supply Base Management (Strategies for Better Managing Suppliers at the Major, Minor, and Scouting Levels) • Supply Base Configuration • Choosing Flexible Supply Chain Partners
4 **Buffers**	Creation of excess cushions in the form of inventory, capacity, or lead times.	• Human Resources – Capacity • Human Resources – Capability/Experience • Inventory • Operating Flexibility • Excess Operating Capacity • Redundancy • Excess/Safety Lead Time
5 **Operating Flexibility**	Changing either flows or product specifications in response to supply chain problems.	• Transportation Alternatives • Variable Bills of Material
6 **Security**	Protecting the system from supply chain shocks in the form of theft, damage, or counterfeiting.	• Firewalls • Quarantine • Strengthened Physical Systems
7 **Preparedness**	Designing contingency plans for possible supply chain shocks and testing of plans so that the various groups know what they must do and what their specific responsibilities are.	• Planning for Contingencies • Training/Rehearsing • Risk Assessment • Insurance
8 **Indirect Investments**	Applying investments in other areas that can be drawn on by the firm when a shock occurs. Typically, these investments create goodwill or a willingness to let the firm address its supply chain problems.	• Marketing Position/Brand Equity • Supply Chain Capital • Relationships with Suppliers • Relationships with Customers • Supplier Loyalty • Customer Loyalty • Support for Innovation • Support for Dynamic Partnering • Revenue Management

Source: Michigan State University

Yet, in studying the events that took place at Fukushima, one can see the interplay of risk and uncertainty. When the plant was first built in the 1960s, the expected maximum height of a tsunami was 5 meters (16.4 feet); the seawall built at the plant to resist this potential risk event was 5.7 meters (19 feet). The tsunami-generated wave that hit the plant was 13 to 15 meters (43 to 49 feet) in height. This event reflects the uncertainty that is always present. While plans were made to resist a tsunami wave, the planners did not foresee such a large tsunami hitting the plant.

You could argue that what Fukushima Daiichi needed was a system that was ideally hardy but at a minimum was vulnerable but responsive. Instead, what they had was a system that was resistant but sluggish. The notion of a resistant but sluggish supply chain and a vulnerable but responsive supply chain may also be considered in this context of supply chain risk and supply chain uncertainty.

Under conditions of uncertainty, such as in the fashion industry, the best approach to building resilience may be to invest in the capacity to recover from an unpredictable disruption. On the other hand, faced with the known risk of a chemical spill, the chemical industry's policy of avoiding such disruptions is more appropriate, especially given the extent of the damage that would otherwise result.

By differentiating between risk and uncertainty, we can uncover an important rule of thumb for resilience: When faced primarily by risk, it makes sense to invest in improving resistance; when dealing with uncertainty, it is more appropriate to invest in improving recovery capabilities.

Investing in Supply Chain Resilience

Resilience can be more properly regarded as a derived system property. That is, it is the result of the investments a firm makes over time, not a 'free' benefit of existence. Moreover, it can be generated through many different types of investments. These are summarized in Exhibit 5.

Some of these investments, such as inventory and capacity buffers, are direct investments. Investments in safety stock or increased lead-times buffer the system

much like the shock absorbers on an automobile smooth a bumpy road.

Indirect investments in areas such as brand equity and customer loyalty can also have an impact on resilience. While these investments are not focused directly on enhancing the resilience of supply chain systems, they offer capabilities that the firm can draw on to deal with unexpected breakdowns in its systems. As detailed in the sidebar, indirect investments in brand equity and relationships with customers enabled Proctor & Gamble to recover from production problems when it introduced its Tide Pods product.

Furthermore, these investments can be mapped to specific stages within the four phases of resilience. The challenge for the firm is that of determining the choices between concern for supply chain risk or uncertainty and determining which quadrant (as illustrated in Exhibit 4) is both most appropriate and as representing the best value for the firm's investment investments.

Exhibit 6 illustrates that many of these investments affect multiple stages of resilience. Note that these investment values are qualitative approximations of value; other values may be realized in various types of supply chain situations. In reviewing this exhibit, also note that the strength of the impact is indicated by the greenness of the shading—a moderate impact is denoted by + and yellow shading; a strong impact is denoted by ++ and green shading.

EXHIBIT 6

Alternative Investments in Resilience and Their Impact on Avoidance, Containment, Stabilization, and Return

Strategies	Avoidance	Containment	Stabilization	Return
Indirect Investment	0	++	0	0
Discovery	++	0	0	0
Information	++	+	+	+
Supply Chain Design	+	++	++	+
Buffers	+	++	++	0
Operating Flexibility	0	++	++	++
Security	++	++	0	0
Preparedness	++	++	++	++

Source: Michigan State University

This exhibit provides example categories that can be mapped to the four phases of resilience. It also suggests how resilience investments affect the four phases of resilience in differing ways. What it does not convey is the nature of the impact—whether it is through main effects (where an investment such as supply chain design affects directly resilience) or through interactions (the interaction between two or more factors found in the table).

P&G's investment in resiliency

In August 2011, Proctor & Gamble announced the introduction of the Tide Pod. This was an innovative detergent delivery system combining a detergent, stain remover, and brightener into one easy-to-use pod. The product was intended to increase demand in what had become a mature market. Unfortunately, P&G had to delay the actual market entry date until early 2012 due to production challenges that limited how much product would be available at retail outlets to support a broad product launch. The breakdown gave P&G's competitors in the home laundry market segment an advanced warning of P&G's intent and a chance to seize market share in the more profitable one-dose, convenience market segment.

Still, P&G was able to correct the original supply chain problems and recover from these disruptions. By December 2012, P&G was projecting first year retail sales totaling $500 million for the pods. Given that most new products are considered a success if they achieve $50 million in sales, this turnaround is significant. Moreover, because of production constrained product scarcity, P&G has offered no promotions or discounts on the sales of this premium-priced product.

One reason for P&G's ultimate success, despite their supply chain challenges, can be found in the indirect investments that P&G has made in brand equity and customer loyalty.

In other words, Tide brand loyal customers trusted the Tide brand, and despite market entry by competitors' all-in-one detergent products, P&G's customers were willing to wait until P&G resolved their supply chain problems and brought their product to market.

No More Happy Accidents

While there is a great deal of confusion about supply chain resilience, it really comes down to two separate but interrelated elements: resistance and recovery. Further, where your firm chooses to invest in building resilience is really a function of whether you are faced by uncertainty (in which case you invest in recovery) or risk (which justifies the investment in resistance).

Managers can make those investments in supply chain resilience through multiple venues in ways that are both appropriate to the risks a firm wants to mitigate and that make sense to the parties involved. The result is that resilience is now becoming a supply chain property that supply chain managers can shape and influence. That happens by design and is no longer a happy accident.

Countdown to Conflict Minerals Reporting

In less than five months, U.S. companies whose manufactured products contain conflict minerals will have to file their first compliance reports with the SEC saying where the minerals are coming from, and, in some instances, whether the minerals are benefiting armed groups in some African countries. The SEC's conflict minerals rule is complex, and many companies are struggling to comply. In fact, they will be challenged for some time to come. Here are PwC's recommendations for the four stages of readiness.

Kelvin Harris, Geoffroy de Carbonnel, and Kassie Bauman

The clock is ticking—loudly. By May 31st this year, public companies have to comply with the U.S. Securities and Exchange Commission's Conflict Minerals filing requirement. This is not a job for the legal department alone: It will require active input from operations leaders—notably from supply chain executives. Nor is the filing just a one-off requirement: It will call for ongoing effort far into the future.

The rule is one of several SEC rules mandated by the Dodd-Frank Act that are intended to provide transparency into corporate practices. In the case of this regulation—Section 1502 of the Act—the ultimate intent is to reduce funding for armed groups involved in human rights violations in the Democratic Republic of the Congo (DRC), Angola, Burundi, Central African Republic, the Republic of the Congo, Rwanda, South Sudan, Tanzania, Uganda, and Zambia (collectively, "the covered countries").[1,2]

The four so-called "conflict minerals"—tantalum, tin, tungsten, and gold—are primary sources of funding for the armed groups. Also known as "3TG," these materials are essential to the production of countless products. They are fundamental in electronics equipment of all types, to be sure, but they are also critical to the manufacture of everything from drill bits and golf clubs to jewelry,

Kelvin Harris, Geoffroy de Carbonnel, and Kassie Bauman are members of PwC's global conflict minerals team. They can be reached at kelvin.harris@us.pwc.com, geoffroy.de.carbonnel@us.pwc.com, and kathleen.bauman@us.pwc.com. For more information, visit www.pwc.com/us/conflictminerals.

Photo by Tom Stoddart/Getty Images

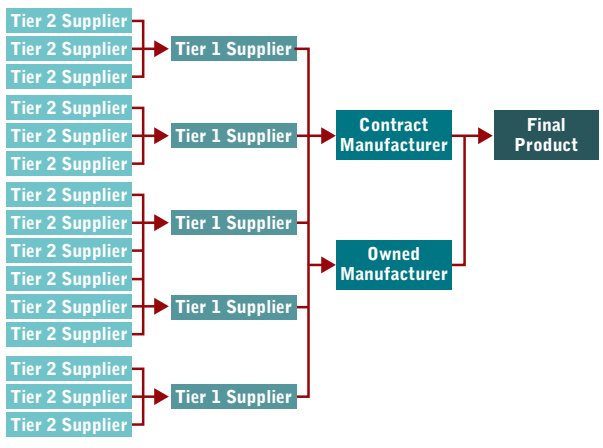
zippers, and buttons. They are even used in some types of PVC and glass.

The SEC rule compels corporate disclosures around whether any of the 3TG materials used in a company's products originated in any of the covered countries, and if so, whether these conflict materials are "conflict free" or not. The impact of the rule reaches far beyond the 6,000 SEC "issuers" (public companies that issue shares) that are directly within the scope of its rule, with the SEC estimating that 275,000 privately owned enterprises that are part of the issuers' supply chains will also be affected. (See Exhibit 1 on the following page.)

For most companies, complying with the rule has been anything but straightforward. It is often difficult to determine which products are subject to the rule due to lack of comprehensive bills-of-material, or because information is scattered across multiple teams and systems. Nor is it easy to get all the pertinent suppliers to engage with the compliance effort. Even when suppliers do provide information about conflict minerals, it is often incomplete, inaccurate, or inconsistent, so the recipients of the information may find themselves questioning whether the supplier fully understood what was being asked. They may also then wonder how to know or effectively judge that the answers are reliable? This and a host of other questions are on the minds of SEC counsels as well as sustainability, compliance, product, and sourcing teams all across the United States.

EXHIBIT 1

Even a Simple Supply Chain Can Have Many Potential Purchasers of Conflict Minerals



Source: PwC

Such questions cannot be deflected to third parties. While some companies may choose to outsource the process that supports their Section 1502 filings, they cannot outsource their accountability for doing so. With a product's conflict status often being a subjective judgment, coupled with the fact that a company officer must sign the SEC Form SD, many issuers are carefully considering which parts of the conflict minerals process they want to outsource and which they want to continue to "own." And of course, they are determining that any outsourced provider is following an appropriate process that aligns with all the necessary requirements.

The SEC's conflict minerals filing is not just a one-off requirement: It will call for ongoing effort far into the future.

Some of the answers will come only with time and additional guidance from the SEC. But many companies are making substantive progress and seeing success in their efforts. The critical factor in all of these programs is tackling their Section 1502 obligations as a cross-functional effort, with supply chain leaders at the forefront. In fact, some supply chain executives are using the SEC mandate in strategic ways. In some organizations, it is seen as an opportunity to work with other departments to build a brand around "conflict free" status. In others, it is helping to deepen the understanding of product portfolios and sourcing programs and enabling supply chain leaders to use that knowledge to rationalize and improve supplier relationships and further streamline supply chain efficiency and effectiveness. And at some companies, the SEC mandate provides an opportunity to tie conflict minerals compliance to other responsible sourcing and sustainability programs and connect it with other supplier, product and materials risk, and regulatory requirements.

In many cases, companies have realized that the regulation creates staffing challenges. Many are adding responsibilities to existing roles or adding headcount to sourcing, product management, materials compliance, and supplier management teams. Those with more extensive product and supplier exposure are also using technology tools to help manage the process, particularly to ensure consistent execution and to establish a documented audit trail.

So with less than five months before the first filing date, how are companies faring with their compliance efforts? PwC currently sees companies at four stages of engagement:

1) a small minority of companies that have yet to start;

2) many that have started but are not anticipating anything beyond a basic "reasonable country of origin inquiry" (RCOI), perhaps because they have been overwhelmed by the complexities involved;

3) the majority that are on track with their RCOIs and that will have performed some level of due diligence by the filing date; and

4) some that have completed due diligence and been able to determine whether some of their products are "conflict free" or not. (Very few will have been able to make that determination for all of their products.)

Here are the recommendations—stripped down for the purposes of this article, of course—that PwC suggests can help supply chain executives who identify with any of these four stages. Importantly, the suggestions in later sections are also relevant for managers who relate

to earlier stages of compliance; after all, they will eventually have to go through those stages too.

Stage 1: We still haven't started our compliance effort.

Some business leaders are realizing, very late, that Section 1502 applies to their organization. In some cases, the sheer complexity of the compliance mandate has produced a degree of paralysis. Others may have been waiting for additional SEC guidance.

There is a matter of weeks left in which companies, if they begin now, can make sufficient progress to demonstrate some initiative in the first filing.

The critical first step is to thoroughly familiarize the executive team with what needs to be done and when. The rule outlines a process to help issuers determine whether they are subject to its requirements, and if so, what they should do.

Once an issuer determines that it is subject to the rule—that its products do have conflict minerals in them—it must conduct a reasonable country of origin inquiry (RCOI) to determine whether any of its conflict minerals originated in the covered countries, or are from scrap or recycled sources. All issuers subject to the rule will be required to file Form SD with the SEC; however, the extent of the disclosures and the requirement to file the consequent conflict minerals report (CMR) and have a portion of its CMR disclosures audited varies depending on the outcome of the RCOI and any other required due diligence.

To assist with understanding the SEC requirements, a simple decision tree shows the possible outcomes (see Exhibit 2).

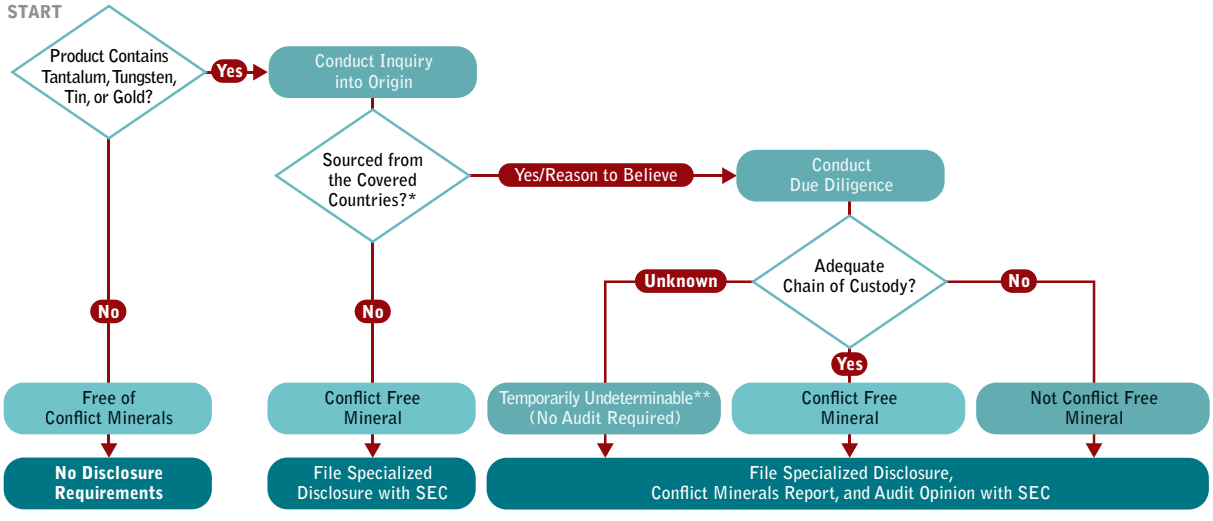
The second step is to quickly build a cross-functional team to meet the mandate; Section 1502 compliance is not a one-department job. Although legal counsel will be heavily involved at the outset, the effort clearly has to involve the supply chain—usually at a minimum, individuals in sourcing and procurement, and often also in product management and supplier management—along with managers from IT, sustainability, and even internal audit.

A third fast-track step is to tap into all the expert resources available to help with executing the conflict minerals initiative—resources ranging from consultants to trade associations and even to competitors and peers. Many organizations have studied the Section 1502 rules in detail and many issuers have already learned by doing, so there is a wealth of knowledge already available.

The last key steps are to determine what the RCOI survey will contain and to identify the key individuals at each supplier who need to respond to the survey. To structure the RCOI survey, many companies are utilizing

EXHIBIT 2

A Basic Conflict Minerals Decision Tree



* Covered countries under the rule are the Democratic Republic of the Congo, Angola, Burundi, Central African Republic, the Republic of the Congo, Rwanda, South Sudan, Tanzania, Uganda, and Zambia.

** Companies would reach this conclusion if they cannot determine whether their conflict minerals benefited armed groups. But this option is only available for the first two years, four years in the case of small companies.

Source: PwC

The impact of the rule reaches far beyond the 6,000 companies that are directly within its scope; the SEC estimates that 275,000 privately owned suppliers will also be affected.

the electronics industry's EICC-GeSI template; most others are using a survey that is similar to EICC-GeSI but which contains adjustments to clarify the questions and minimize the work required once a response is obtained.[3]

PwC is seeing a number of companies that provide supplier training before the surveys are issued; this has the benefit of being able to ensure suppliers understand the questions (for example, to explain terms from the rule such as "necessary to functionality"), as well as enabling the company to place greater reliance on supplier responses. It also is an effective and fairly simple way for the company to get early warning of any potential issues and to demonstrate they have taken steps to ensure their suppliers understand the importance of providing a response.

This list of steps is hardly exhaustive, of course, but each will help companies make substantive progress with their compliance efforts fairly quickly.

Stage 2: We issued the RCOI survey, but now there's so much work to do with our suppliers.

The many companies that are at this stage are busy evaluating responses from suppliers. There is significant work to be done, of course, in handling and interpreting the responses; it can involve extensive to and fro with those supply chain participants.

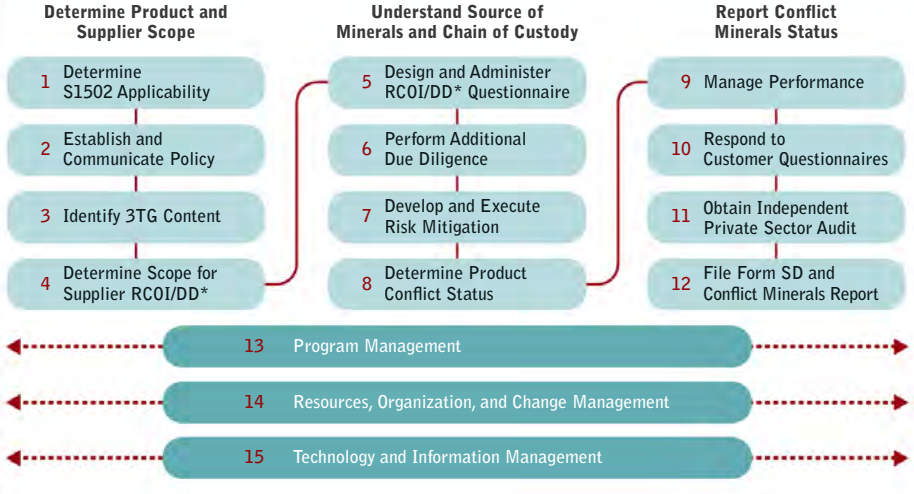
However, it is easy to fall into the trap of working hard to capture every detail. That is especially challenging with large organizations that have multiple divisions, complex product ranges, and long lists of suppliers. With limited time and resources, it is essential that companies "work smart," concentrating on the most critical compliance issues and prioritizing the suppliers whose products or responses to the RCOI require most scrutiny. (See Exhibit 3.)

Arguably the most critical of the compliance issues now is whether to initiate the additional due diligence as required by the rule, using the framework mapped out by the Organisation for Economic Co-operation and Development (OECD)—the only nationally or internationally recognized framework that currently fits the guidelines required by the SEC. (See Step 6 on Exhibit 3.)

Companies need to determine how they will evaluate RCOI responses—that is, how they gauge the reasonableness of the RCOI answers and address responses in areas they have identified as red flags. Perhaps the RCOI surveys received from suppliers don't provide enough information to make a determination. Or perhaps they do, but the company has not defined what due diligence

EXHIBIT 3

Sample Conflict Minerals Program Architecture



* Reasonable Country of Origin Inquiry/Due Diligence

Source: PwC

procedures it will follow and what constitutes effective due diligence to reach a firm conclusion about the products' conflict status. Companies can (and do) spend months attempting to perform due diligence. But with a matter of weeks before May 31, over-analysis will work to their detriment and more success will be achieved by defining a robust process and demonstrating the progress made. The "undeterminable" option will be available for companies on Form SD—realizing, of course, that work should have been done to reach that conclusion.

The other element of the process, to which many companies are already responding, is communicating results to customers that are SEC registrants subject to their own Section 1502 filing requirements. (See Step 10 on Exhibit 3.) Some customers have already stated that they want the products sold to them to be conflict free (which can create its own problems if a supplier does not yet intend to make that statement itself). This creates challenges, particularly in the case of tungsten and tin, where so few smelters are certified as conflict free, or when the information a company has received to date may be inadequate to be able to provide that confirmation.[4] Whatever the determination about conflict status, it must be communicated clearly, candidly, and consistently to customers.

For companies that have to perform due diligence (Exhibit 2), corrective action planning and risk mitigation also loom larger at this stage. (See Step 7 on Exhibit 3.) Although companies must be able to disclose and describe, in the CMR document, what they are doing to ease the risk that their conflict minerals might be benefiting armed groups, they also have to pay attention to the risk mitigation that may be required in case of scrutiny by an NGO, or by a customer.

At the same time, companies have to decide, practically, how they will complete Form SD and the CMR and what levels of detail to provide. Although the requisite elements to be included are defined in the regulation, there is not currently an established format, language, or level of detail for disclosures. So it will be necessary to rely on the community of advisors, such as third-party audit firms, trade associations, and consulting firms, which can provide their perspectives and precedents for completing the documentation. In early examples of draft filings, PwC has seen a wide range of detail, ranging from high-level documents of just a few pages to very detailed lists of products and smelters spanning nearly 50 pages.

Stage 3: We still need to complete the due diligence process.

Executives at the many companies that have made a strong start to the imminent filing may feel some relief that they are close to completion. Yet they may feel anxious that they have missed some crucial steps and may fall short of important parts of the mandate. Or they may be daunted by the volumes of data that have come back from the RCOI, unsure how best to marshal resources for purposes of Section 1502 filing, or how best to seek more information from a supplier.

The later stages also involve proper preparation of the CMR. That may require readiness for an independent private sector audit, if the conclusion is something other than "undeterminable." The CMR is required if the company concludes that its conflict minerals are sourced from the covered countries—or if there's reason to believe they are. A company that is unable to determine whether its conflict minerals are conflict free is allowed a temporary two-year period (four years for smaller reporting companies) to describe its minerals as "DRC conflict undeterminable"—a classification that refers not only to the DRC but to all the covered countries. During that period, the company is still required to perform due diligence and file the CMR that describes the steps taken to improve due diligence and mitigate the risk that its conflict minerals are benefiting armed groups.

It is often difficult to determine which products are subject to the rule. Nor is it easy to get all the pertinent suppliers to engage with the compliance effort.

An independent audit is required when it is learned that the issuer is sourcing from the DRC or other covered countries, and when it is possible to conclude that a product is conflict free or not. The purpose of the audit is to make sure the design of the issuer's due

diligence framework conforms to the OECD framework, and whether the description of the due diligence measures in the CMR is consistent with the process undertaken. (The audit requirement is waived for temporarily "undeterminable" products during the transition period mentioned above.) It is good practice to consider a trial-run audit readiness assessment to identify any gaps and enable the company to close them.

Throughout the process, it is crucial to document on the run—chronicling all key decisions, processes, and outcomes from the very start. This includes not only supplier surveys, but also decisions such as product and supplier scope, and other key judgment calls around interpreting the Section 1502 rule. That effort will be of benefit for executing the compliance program in future years, as well as for filing and audit purposes. It will also help companies when it comes time for preparation and review of the SEC filings, by minimizing relevant lead times and facilitating the internal "certifications" that the executive officer signing the filing might require. The internal audit group may be able to assist with this effort.

It is also good to keep watching out for changes in the Section 1502 issue. Last year, a major court challenge held up the compliance process for many companies that believed the challengers might be successful. Also, guidance on the rule continues to evolve, so it is important to stay current with the latest interpretations to ensure that due diligence activities are correctly focused on in-scope products. Industry associations and external advisors can help to validate "gray area" items.

Stage 4: We've met this year's compliance mandate—but what next?

Congratulations are in order for the organizations that have successfully checked all the boxes needed to meet the SEC's requirements by May 31 this year. But any celebration will have to be quick: Next year's compliance deadline will be here before we know it. Eventually, of course, all companies will reach this stage, so the following points are relevant for all.

This past year has been a time to learn about the conflict minerals regulation and to understand what exactly is "compliance." However, success is not only about compliance: It's also about customers, non-governmental organizations (NGOs), activist investors, and many other categories of stakeholders. In the future, these constituencies will become more organized and focused on companies' relative progress compared to that of their peers; those stakeholders are increasingly likely to drive companies to be conflict free. PwC is already seeing some NGOs that are publishing ranking charts of perceived progress. Certain US universities are responding to the Conflict free Campus Initiative by passing resolutions to purchase only from companies that are conflict free.

In transcending the basic "compliance only" approach to the use of conflict minerals, companies can actually use the SEC's ruling for competitive benefit. The transparency that the rule brings is already encouraging some strategically minded companies to turn their conflict free status or initiatives into a competitive advantage. Companies that sell to retail consumers—in particular, the youth demographic—may have the greatest potential here.

In any scenario, it's certainly appropriate to think in terms of laying the foundation for long-term success—for effective, sustainable compliance year after year. In doing so, companies should take stock of what they did well and what didn't work so well thus far. The focal points for subsequent years should include: any aspects of current levels of compliance that can be improved; close attention to what customers and other stakeholders are expecting; and how the reporting process can become more effective and efficient.

In other words, companies can take only a quick breath before they have to start preparing to reinforce and streamline their conflict minerals compliance processes

in readiness for next year and the years beyond.

Practically speaking, then, what steps must companies take to prepare for the compliance deadlines in future years? At this stage, supply chain leaders must use risk assessment to channel their resources and create a multi-year plan for Section 1502 compliance. By prioritizing their supplier bases, they can understand which suppliers are most important to their compliance efforts. Many other risk factors such as supplier performance metrics and red flags will help assess the quality of supplier responses and make it easier to align resources to manage critical relationships. Importantly, risk assessment must be thought of as a continuous process which is leveraged during implementation of each year's compliance program and which evolves over time—not a discrete one-off activity.

Companies can also start looking at their SEC obligations from the outside in—specifically, from the perspective of the stakeholders described above—to look for ways to make their filings more forward-leaning in the future. They can also start talking with suppliers much earlier than they've perhaps been able to do during this first cycle. It is to everyone's benefit to develop increasingly robust approaches to the Section 1502 ruling; in turn, that calls for rich, ongoing dialog with suppliers.

That dialog must begin now; companies must not wait until October or November this year to send their first surveys to suppliers. It is crucial to communicate expectations now about what other kinds of questions will be asked, what next year's compliance cycle will involve, what suppliers' own reports should contain, and so on.

Learning From Compliance

So what can organizations learn from going through this initial experience of complying with Section 1502 of the Dodd-Frank Act? First, business leaders must know that everybody is working through this for the first time, so there are no "winners" and "losers" at this point. The SEC will be looking for filing compliance, but there is still an open question about the extent to which the regulators will focus on the accuracy or completeness of Form SD filings.

What's much more likely is that top management will start to require higher levels of conflict minerals reporting—and will begin to push for the use of 3TG materials that are conflict free, as well as recognizing the need to demonstrate greater supply chain transparency. No business leader wants to see the company pilloried for appearing at or near the bottom of an NGO's "list of shame" of conflict mineral users.

PwC is confident that most businesses will quickly learn what is needed to meet all future Section 1502 reporting criteria. In the next couple of years, it is very likely that some companies will succeed in turning the ruling to advantage. And it's possible that some retail stores will start to carry at least a few "conflict free" labeled products. It will be interesting to observe which companies and sectors are the first to wear the conflict free mantle—and demonstrate real commercial success.

Companies can use the SEC's ruling for competitive benefit. The transparency that the rule brings is already encouraging some strategically minded companies to turn their conflict free status or initiatives into a competitive advantage.

Sources:

1 http://www.pwc.com/us/conflictminerals

2 The Price of Precious, National Geographic, October 2013, http://ngm.nationalgeographic.com/2013/10/conflict-minerals/gettleman-text

3 The EICC/GeSI template is a widely-accepted survey template used by companies to gather conflict mineral sourcing information from their suppliers. It is available to the general public for use, and can be obtained by visiting: http://www.conflictfreesmelter.org/ConflictMineralsReportingTemplateDashboard.htm

4 More information about conflict free smelters is available from the Conflict Free Smelter program: http://www.conflictfreesmelter.org/CFSindicators.htm

Six Driving Forces in Manufacturing

Manufacturing is once again a hot topic in public debate and on boardroom agendas. Companies that can accurately anticipate how these important changes will affect their manufacturing strategy can turn challenges into profitable opportunities.

by Patrick Van den Bossche

As the latest waves of change gather momentum, manufacturers face decisions that could create opportunities or competitive challenges as significant as Eli Whitney's idea of interchangeable parts or Toyota's improvements on Henry Ford's assembly line. As a result, the future of manufacturing is again a hot topic in public debate and on boardroom agendas. Companies are looking for a unique competitive edge or ways to respond to the unexpected. Manufacturers that can accurately anticipate how these trends will affect the various elements of their manufacturing strategy, such as the future need, location, and size of factories; the potential role of big data in improving productivity; workforce implications; and the level of automation, can turn challenges into profitable opportunities.

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Driving Forces in Familiar Areas

A first driving force is rooted in new manufacturing technologies, which are emerging faster than ever. Some of them, such as collaborative robots and 3-D printing, are already disrupting the long-established environment on the factory floor and have the potential to fundamentally transform or even replace conventional manufacturing operations.

Future human-robot collaborations will combine human agility and intelligence to solve problems with the durability and precision of robots, at a much lower cost than today. Supported by easy and quick programming, such as motion or voice control, this new collaboration is likely to lead to a marked change in productivity and profoundly affect the traditional factory model overall. Also making inroads is 3-D printing: The global market for this technology is rapidly growing at 20 percent year-on-year and is estimated to reach between $25 billion and $50 billion by 2025. No wonder, because the potential benefits, whether from reduced manufacturing costs, improved lead times, or better quality, can be tremendous. And the ability to manufacture additive, individually customized products at a previously unachievable small scale, low cost, and short lead time could open up whole new markets.

With manufacturing technology heading in dramatic new directions, keeping pace with it is more important than ever. Actively scanning the new technology frontier regularly to position your company to capitalize on opportunities is a must.

A second driver that is likely to be familiar is the necessity to go beyond the classical improvement methodologies, such as Lean. Since the early days of the Toyota Production System and the buzz generated in 1990 by the book "The Machine That Changed the World," thousands of companies have launched initiatives to eliminate waste in their factories, and more recently in their back office functions. Successful lean companies have achieved year-on-year productivity improvements of as much as 10 percent, while others have struggled just to compensate for moderate wage inflation. With lean being ubiquitous, the question is: What comes next?

The answer is two-fold. First, after Lean comes "more Lean." Many companies are still applying Lean to only a portion of their manu-

facturing operations, thereby leaving significant opportunity on the table. Second, those that have rolled out Lean in most nooks and crannies of their organization will be looking beyond their own Lean production and management systems to systematically expand their scope beyond manufacturing by going after both input factors and supporting functions and even reaching beyond your own company's borders.

So when it comes to finding the next productivity frontier in manufacturing operations, expand your horizons by revisiting the effectiveness and scope of existing Lean initiatives and work together with both internal functions and other players in your company's ecosystem, (e.g. suppliers, customers, etc.) to find additional joint productivity opportunities. Collaboration both across functions and across traditional company boundaries is paramount.

A third driving force that should be familiar to manufacturing executives is that shifting labor relations will increase the number of relationships that need to be managed. Despite increasing automation, people still remain among the most important resources to any manufacturing operation. That's reason enough to shift interactions with workers higher up on the priority list.

It wasn't so long ago that unions were losing members and seemed to be losing influence in companies and in politics. Yet today, almost everywhere in the world, workforces have established increasing numbers of networks and groups representing their interests to counterbalance the union decline. In previously non-unionized countries, such as China, organized labor's political and operational influence is growing. And even in Western economies, specialist unions that represent small groups are on the rise and are successfully exerting their influence. As a result, rather than having to interact solely with large unions, a new, more fragmented landscape is emerging.

Being strategically and tactically ready for this new situation is vital and the importance of moving toward a better model of cooperation with your workforce in a way that fosters a true entrepreneurial spirit can't be overstated.

Potential Blind Spots

The transformation of the Chinese manufacturing industry is another driving force that should be on every manufacturing executive's agenda, not only those with factories in China, but also those in the West, for whom this may be a bit tougher to grasp. Due to rising labor rates, the Middle Kingdom is losing its status as the lowest cost country in the public debate. Yet, the pace at which China has developed during the past 10 years makes it likely that it will continue to advance rapidly. A shift from low technology and low productivity manufacturing to high technology and high productivity is already happening, although at a fairly moderate pace, as many Chinese companies adopt automation to compensate for higher labor costs.

As many believe that the power shift from West to East has come to an end, it probably sounds surprising that we would still call for action now, beginning with a review of your existing footprint strategy and the productivity levels that will be required to respond to the ongoing influence and competition from the East. The Chinese dragon may be resting after an exhausting 10 to 15 year run, but one would be remiss to think that he's dead, as some U.S. reshoring advocates seem to be doing.

A second driver on the periphery of the manufacturing executive's vision could be the need to achieve true end-to-end optimization, from raw materials to recycling. Today, the tendency in many companies is still to focus on core competencies, with manufacturers transferring numerous functions to suppliers and other third parties. The extent of vertical integration often decreases in the process, as is the case in the German automotive industry. At the same time, a company's influence over its own manufacturing cost structure has waned. To realize full manufacturing potential, requires adopting a true end-to-end perspective that expands optimization, from raw materials suppliers to end consumers and even into recycling, to get back into the driver's seat.

Lastly, there's a clear drive to make sure you know and understand the elevated risk and volatility that will challenge your global supply chain. Supply chains have developed rapidly in the past decades but as they have become more global and efficient, they are also more exposed to different and higher risk levels. Natural disasters and economic disruptions have caused immense financial and reputational damage to global supply chains.

Clearly, mitigating these risks is a crucial aspect to which manufacturing executives can't be blind if they want to safeguard material flows that occur upstream in the supply chain. Integrating manufacturing with risk management for the entire corporate supply chain is a strong first step. However, it is equally vital to fully understand the changes and risks in your extended supply chain including those that could affect the industries of your suppliers and customers.

Prepare for Rapid Change

The business world often takes manufacturing for granted, even in manufacturing companies. But when disruptive trends change manufacturing in fundamental ways, all eyes turn to those capable of navigating the rapid shifts with insightful and responsive strategies. Adopting an approach that isolates and evaluates the most relevant trends in your manufacturing business is essential for formulating strategies that deliver both an immediate impact and a longer-term advantage.

Ready To Corral

The economic recovery that began in mid-2009 continues to gain traction; and with the exception of parcel, freight transportation rates will only make incremental gains in 2014. However, our top market analysts tell us that controlling total landed costs by using a variety of modes is now imperative.

By Patrick Burnson

While the Institute of Supply Management (ISM) reports that economic activity in the manufacturing sector was strong for the sixth straight month, supply chain executives may still wish to examine this "exuberance," say economists. Transportation rates are unlikely to surge this year, no matter how vibrant the manufacturing sector remains.

According to ISM, manufacturing firmed once again at the end of 2013, climbing to its best level since April 2011 in both production and new orders. But there's still reason for skepticism, says Michael Montgomery, U.S. economist with advisory firm IHS Global Insight.

"The problem remains the chronic lack of confirmation in government data on manufacturing," he says. "It shows gains as barely over tepid growth, but the ISM report hardly indicates robust or even solid growth." Montgomery adds that the surveys seem to be reporting that the strengthening is broad-based, and that the most recent industrial production data did show gains. But what does it take for gains to be both broad and deep? The answer is simple, say IHS economists, who contend that the world manufacturing and goods trading markets need to all be moving in synch.

"Right now the world is growing at several different speeds," says Montgomery. "The U.S. and Japan are both reporting good gains in the surveys. The UK is booming, but the Eurozone and China are struggling with very modest gains." He adds that if China and Europe can catch up to the growth pace of the other three, then the manufacturing sector will be on a roll. "If that's the case," says Montgomery, "with one side of the ocean pushing the other to strength, that in turn will spur growth in the first."

But it's that synchronization that's currently absent as Europe struggles with its structural problems. Meanwhile, industry experts in the fuel, rail, trucking, air, ocean, and parcel sectors are telling shippers to ready themselves for a gathering concentration of rate hike attempts.

Fuel: Loaded with Uncertainty

Surplus oil production capacity has been an unreliable metric to date, notes Derik Andreoli, Ph.D.c., senior analyst at Mercator International LLC. He adds that, historically, when surplus production capacity declines to 1.5 percent of total liquid fuels consumption, oil prices

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increase and become much more volatile.

"This year, surplus production capacity fell from 3.0 percent of total consumption to 1.7 percent by August, but rebounded to 1.9 percent in September," says Andreoli. "With such a thin cushion, any price forecast will be loaded with uncertainty."

Andreoli adds that if global oil demand picks up faster than producers are able to add capacity, prices will ramp up, and any credible threat of disruption will have the same effect. "Alternatively, production disruptions currently amount to more than 2.0 percent of global capacity, so if just half of these bottlenecks are relieved, surplus capacity could rise to a comfortable level and price pressures would ease."

With these caveats in mind, Andreoli says that weak demand in emerging markets, continued "sustainability" gains in Europe and the U.S., and continued growth in domestic production of shale oil will likely cause oil prices to decline slightly through the first half of the year. Then, he believes price levels will spike in the second half of 2014 as the pace of global economic growth accelerates.

"And as a result, diesel prices are likely to remain elevated, and alternative fuels, especially compressed natural gas, will continue to sell at a steep discount on an energy equivalent basis, even as natural gas wellhead prices rise," says Andreoli.

Trucking: Modest Bump

Andreoli's forecast resonated with Stifel Nicolaus trucking analyst John Larkin, who observes that the expense of diesel will remain stable. Meanwhile, trucking rate increases lost momentum in 2013, as the much anticipated capacity crunch failed to materialize—even after the implementation of new capacity sapping hours of service (HOS) rules on July 1.

"Some truckload carriers were able to push rates up 1 percent to 2 percent on average, with most of those gains realized early on in the year," says Larkin. Others, he adds, were able to push unit revenue up a little beyond that level by applying technology to better select higher rated freight and improving their freight mix.

"LTL carriers also experienced some deceleration in the amount of year-over-year rate increases as the 2013 wore on," says Larkin. A sluggish economy seemed to be the culprit there, he adds.

So, as 2014 looms the question remains: Will 2014 be the year when the capacity crisis actually kicks in and drives trucking rates up mid- to high-single digits?

"While we would like to think that's a real possibility, without the economy shifting into a higher gear this outcome is unlikely," Larkin says. "We would expect more of the same for both truckload and LTL carriers—low-single digit year-over-year rate increases."

Rail/Intermodal: Increase on Track

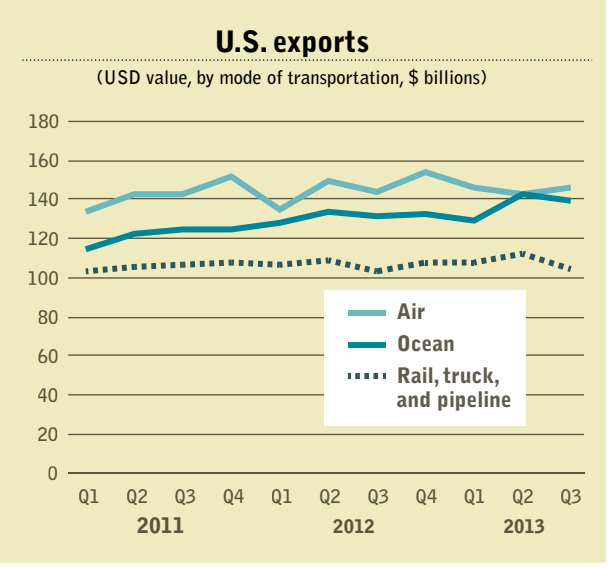
Brooks Bentz, partner in Accenture's supply chain management practice, jokingly referred to "yawns of surprise" when evaluating rates in 2013, and doesn't see a change for 2014.

"I believe that the economy will continue recovering, but at a very modest pace, and that rate making in carload and intermodal will reflect that," says Bentz. "Exceptions may be there in the really hot areas, such as drilling pipe, frac sand, as well as petroleum and gas output. But because there's not

Illustration by Phil Foster

much of a long history there, it will be hard to gauge."

Bentz says that intermodal is doing well domestically and still lagging internationally—a trend he sees as ongoing. The "market changers" will be the willingness, followed by the ability, of some carriers to mount an assault on the shorter-haul markets with their hub-and-spoke approach. According to Bentz, this is a burst of new thinking and an approach to penetrating the market segment that has some of the largest volumes.



"Railway operating efficiency is very strong across the board, but they are still striving to do better, which will make them a very competitive force for a long time to come," says Bentz. "That means, shippers who are new or casual users of rail—either carload, intermodal, or both—should do the due diligence to examine rail as an alternative mode."

Ocean: Hikes Unlikely

An ocean carrier price fixing case currently under investigation by the European Commission (EC) may indicate just how desperate things have become in this freight transportation sector, say analysts for the London-based consultancy Drewry Supply Chain Advisors.

"On the one hand, ocean carriers will argue that they are only doing what they have always done, namely notifying shippers of future price increases in good faith," says Philip Damas, Drewry's director. "Moreover, the way that they've been carrying out the function hasn't gotten them anywhere, as evidenced by the overall downward spiral in freight rates over the past four years." On the other hand, the EC can counter that because the historical practice of announcing general rate increases (GRIs) started, the lack of financial justification for them has become more evident, suggesting that the targeted increases now being implemented are only motivated by supply and demand.

"The EC's legal proceedings are certainly badly timed for the P3 alliance because Maersk, MSC, and CMA CGM need to be seen as responsible carriers in the eyes of industry regulators," says Damas.

Air: Flying Low

Overcapacity seems to be plaguing the air cargo sector as well, says Charles "Chuck" Clowdis, managing director of transportation advisory services for IHS Global Insight. Still, he predicts a slow gradual increase in tonnage by the end of this year's first quarter.

"The European air cargo lanes are increasing, but still have a ways to go despite being up slightly over last year," says Clowdis. "Africa is the only region to show a decline from a year ago."

North American airlines returned to a solid growth rate in October after a slight drop in September. Significantly, says Clowdis, the October increase was not affected by the 17-day, U.S. federal government shut down. Manufacturing activity in North America appears to be supporting demand for air transport of goods produced, but the expansion rates are still extremely small—and three times slower than at this time last year.

"Rates will follow growth but capacity still is abundant and until some is absorbed, rates will still remain sustainably low," concludes Clowdis.

Parcel: No Smooth Skating

No matter how good shippers have become at negotiation, chances are that delivery costs have gone up much faster than they expected, says Jerry Hempstead, president of Orlando, Fla-based Hempstead Consulting.

"The exit of DHL from the domestic playing field some five years ago has left shippers at the mercy of a duopoly," says Hempstead. "Shippers have little recourse. If one marries a carrier, there's a good chance that there are yearly increases built into the agreement someplace."

Hempstead says one of the largest changes since DHL left has been in the escalation of the minimum charge. Shippers with big discounts often experience the jump in minimums the most. Since January of 2009, the ground minimum is up over 35 percent.

"Both FedEx and UPS have experienced laudable earnings growth in spite of a tepid economy," says Hempstead. "Imagine how they might fare if the economy picks up?"

But one mega-shipper may be transforming the scene in the coming years, Hempstead predicts. "Amazon has sent a warning message out to the private carriers," says Hempstead, "that it's willing to explore alternatives to traditional services." Although Amazon may be a big customer of FedEx and UPS, they could become a threat as a competitor—and only time will tell if all three will work together to leverage each other's strengths.

Supply Chain Talent Development is a Work in Progress

Results from an APQC survey reveal that there are skills gaps among candidates, but organizations are adopting ways to develop current and future employees.

By Becky Partida, Research Specialist, Supply Chain Management, APQC

Much attention has been given to the strategic importance of the supply chain management function within organizations. With the rise of supply chain's visibility as a discipline, many universities have established supply chain management degree programs at the undergraduate and graduate level to better prepare individuals for positions in the field.

Despite the attention given to the need for talent development and management in the supply chain, there are still unanswered questions about whether graduates with supply chain degrees are adequately prepared for jobs within the profession and whether organizations are actively seeking employees with these degrees. It is also unclear whether many organizations have established formal supply chain talent development programs to support the employees they do hire.

To gain more insight into talent development in the supply chain, APQC recently conducted a survey of supply chain professionals. Responses were received from 167 individuals representing more than 40 industries. The survey results indicate that the availability of supply chain degrees has not necessarily translated into organizations hiring a large number of professionals with degrees in the field. In addition, new supply chain hires are often only somewhat prepared for the jobs they will be doing. The results also show that although many organizations recognize the need for talent management programs directed at supply chain staff, many have not created such programs.

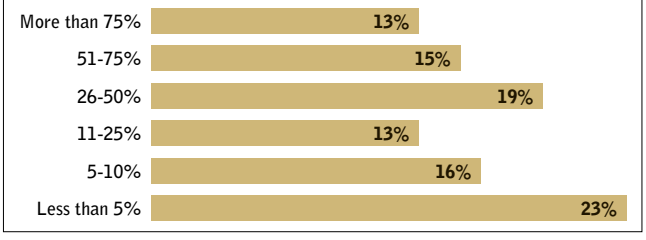
Quality of Supply Chain Candidates

APQC asked its survey respondents to indicate the percentage of their organizations' supply chain new hires that have degrees in supply chain management. Exhibit 1 presents the range of responses APQC received. The largest group of respondents (23 percent) has less than 5 percent of new hires with degrees in supply chain. The second largest group of respondents (19 percent) indicated that 26 percent to 50 percent of their new hires have supply chain degrees.

Overall, a slight majority of the respondents to APQC's survey have 25 percent or less of new hires with supply chain management degrees. This would indicate that, although the number of supply chain degree programs is increasing, it has not necessarily translated into an overwhelming number of supply chain professionals in the field with a specialized degree.

EXHIBIT 1

Percentage of Supply Chain New Hires with a Degree in Supply Chain Management



Survey respondents were also asked to rate how prepared supply chain job candidates were with regard to several areas of the supply chain discipline. The scale ranged from 1, which denoted that candidates were not at all prepared, to 5, which indicated that candidates were very well prepared. The survey respondents rated supply chain candidates' skills, on average, lower than 3.6 on every area provided in the survey (see Exhibit 2).

EXHIBIT 2

Preparedness of Previously Interviewed Supply Chain Candidates

(Mean Rating)

These survey results reveal that individuals seeking to obtain a supply chain position have room for further skill development. The areas given the highest ratings by survey respondents still fell within the range denoting that candidates were somewhat prepared. However, survey respondents indicated that supply chain candidates are better prepared for more basic aspects of the supply chain discipline, such as procurement and inventory management, but are less prepared for more strategic aspects such as international business and financial management.

In another survey question, APQC asked respondents to rate the importance of certain supply chain skills. A rating of 1 indicated that skills were not important at all, and a rating of 5 indicated that a skill was extremely important. Exhibit 3 presents the 10 skills that received the highest ratings from survey respondents and the mean rating for each skill.

The respondents to APQC's survey place more emphasis on "softer" skills for their supply chain talent.

EXHIBIT 3

Importance of Skills for Supply Chain Talent

(Mean Rating)

Respondents rated ethics and problem solving most important, followed by more traditional skills such as customer focus and teamwork. Leadership skills were also among the top 10 rated by the survey respondents, which is worth noting given that survey respondents indicated supply chain job candidates were only somewhat well prepared when it came to leadership experience.

Formal Talent Management Programs

Individuals responding to APQC's survey were evenly split on whether their organizations have formal supply chain talent management programs. To determine how organizations with these programs manage their talent, APQC compared the presence of several aspects of talent management for organizations with formal talent management programs against those without formal supply chain talent management programs. These included:

- making talent management a top priority for the supply chain organization;
- having policies that encourage career growth and development opportunities in supply chain; and
- encouraging advanced degrees among supply chain staff.

APQC asked respondents to indicate the degree to which they agreed that their organizations have adopted these initiatives. Eighty-one percent of respondents from organizations with formal talent management programs agreed or strongly agreed that talent management is a top priority for their supply chain organizations. It makes sense that these organizations would make supply chain talent management a high priority given their investment in a formal talent management program. However, among respondents from organizations without formal supply chain talent management programs, a slight majority (52 percent) also agreed or strongly agreed that supply chain talent management is a top priority for their organizations. Organizations are recognizing that talent management and

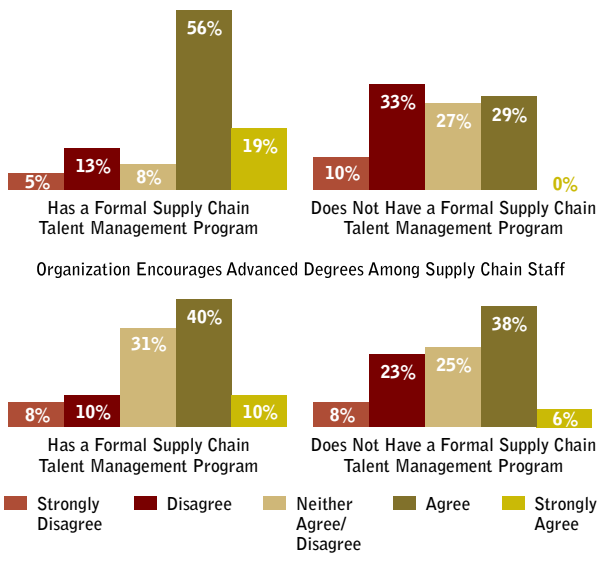
development programs focused on supply chain professionals are needed, even though not all have taken the step of establishing a formal program.

Exhibit 4 presents the survey responses with regard to policies that enable career growth and encourage obtaining advanced degrees. Two-thirds of respondents from organizations with formal talent management programs agreed or strongly agreed that their organizations had adopted policies that encouraged career development among supply chain staff. Only 29 percent of respondents without formal programs indicated that their organizations had adopted these policies and none of the respondents without formal programs strongly agreed. This indicates that organizations with supply chain talent management programs have most likely incorporated initiatives that encourage development of their supply chain professionals. For organizations without formal programs, the results reinforce that these groups are recognizing the need for efforts to develop and retain supply chain staff but have not yet adopted formal programs that work toward that goal.

Less prevalent seems to be an organizational culture that encourages supply chain staff members to obtain advanced degrees. Fifty percent of respondents from organizations with formal supply chain talent management programs agreed or strongly agreed that their organizations encourage advanced degrees, and 31 percent provided a neutral response. Participants without formal talent management programs had similar responses. Forty-four percent of these respondents agreed or strongly agreed that their organizations encourage advanced degrees, and one-quarter of these respondents provided a neutral response.

EXHIBIT 4

Formal Supply Chain Talent Management Programs and Talent Initiatives



Meeting the Demands of the Field

APQC's survey on supply chain talent management indicates that recent job seekers in the field are viewed as only somewhat well prepared for their job duties by their potential employers. This may be a motivation behind many of the respondents' organizations considering supply chain talent management to be a top priority.

APQC's survey also found that many organizations with formal supply chain talent management programs include policies that encourage career growth and development for their employees. This may indicate that organizations are compensating for the skills gaps among new hires by providing development opportunities for these individuals once they have been hired. This is in line with input APQC gathered from practitioners as part of this research. These practitioners indicated that their organizations develop supply chain staff through on-the-job training and rotation programs.

APQC's survey results also reveal that some organizations are taking a more proactive approach toward developing supply chain talent coming from university programs. Most of the respondents indicated that their organizations provide internship opportunities to college students. Forty-three percent of both groups of organizations are working with universities to develop supply chain management curricula for college students.

Clearly organizations are concerned about the recruitment and development of top-notch supply chain employees who can provide the strategic benefit needed by the enterprise. At present, organizations are still encountering skills gaps among supply chain applicants, despite the wider availability of supply chain degree plans and certificates at universities.

To get employees to the skill levels they need, organizations should consider adopting more formal talent development programs that provide supply chain employees with the real world experience necessary for the field. This can be done in conjunction with more traditional internship programs for college students and collaboration with universities to ensure that supply chain degree programs produce graduates ready to enter the work force.

About APQC: *A member-based nonprofit founded in 1977, APQC is the leading resource for performance analytics, best practices, process improvement, and knowledge management. For more information, visit www.apqc.org or call 713-681-4020.*

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OMPARTNERS

A SPECIAL SUPPLEMENT TO:
SUPPLY CHAIN MANAGEMENT REVIEW

Leveraging the Value of Supply Chain Education

With interest in supply chain education at an all-time high, now is the time to expand your team's skills, knowledge, and capabilities.

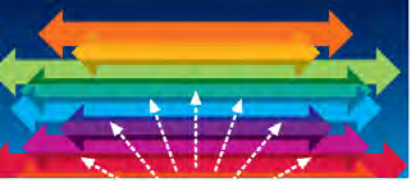
By Bridget McCrea, Contributing Editor

It's no secret that organizations are paying more attention to their supply chains lately. Whether their goal is to minimize risk, improve customer service, enhance visibility, gain competitive advantage, or all of the above, companies are increasingly turning to their supply chains for answers. A logical offshoot of this trend is an uptick in supply chain education. For without the right mix of fundamentals and hands-on experience, how can supply chain managers and their teams be expected to keep up with this newfound interest in what was once their "little corner" of the world?

Calling supply chain management the "Hot New MBA," a recent *Wall Street Journal* article reported that more schools are ramping up their programs and adding majors and concentrations to meet employer demand for such options. And because program graduates are in big demand right now, *WSJ* says salaries for these jobs range from the mid-50s and up into the six-figure range, depending on education and experience. An MBA in supply chain management from Arizona State University, for example, can fetch an average starting salary of $97,481 (compared to $92,556 for all MBAs).

The salaries associated with supply chain careers are impressive, for sure, but the path from the classroom to the paycheck isn't always well paved or navigable. According to a new APQC survey, skills gaps can get in the way of individual achievement and corporate goals. "Despite the attention given to the need for talent development and management in the supply chain," the APQC states, "there are still unanswered questions about whether graduates with supply chain degrees are adequately prepared for jobs within the profession and whether organizations are actively seeking employees with these degrees." (Also see this month's Benchmarks column on page 54.)

In some cases, the skills gap exists because companies have yet to set up supply chain talent development



programs to support new hires. In its survey of 167 supply chain professionals across 40 industries, for example, APQC found that new supply chain hires are often only somewhat prepared for the jobs they will be doing. And while organizations recognize the need for talent management programs directed at supply chain staff, survey respondents were evenly split on whether their organizations have formal supply chain talent management programs.

When conducting its survey, APQC also found that their potential employers view recent job seekers in the field as only somewhat well prepared for their job duties. "This may be a motivation behind many of the respondents' organizations," the group states, "considering supply chain talent management to be a top priority." Some organizations are taking a more proactive approach toward developing supply chain talent coming from university programs, according to APQC, which found that most organizations offer internship opportunities and 43 percent work with universities to develop supply chain management curricula.

"The speed of change is very fast right now. The professionals with the skills and the training are at an advantage and able to differentiate themselves from the rest."

—Nick Vyas, senior program administrator for global supply chain management, the University of Southern California

Public, Customized, and Hybrid

At Pennsylvania State University, John Langley Jr., PhD, says he's seeing strong interest in supply chain education reinforced by industry certifications and certificates. The latter often serve as "tangible evidence" that a formal effort was put out to enhance one's education, says Langley. Concurrently, he says more organizations are sending employees to schools like Penn State to attend either public, customized, or hybrid educational programs. At press time, for example, Langley was kicking off a three-day hybrid course for a particular company that was part-traditional learning and part-tailored to the company's specific business.

When it comes to addressing talent gaps on a current supply chain team, Langley says the hybrid educational approach works particularly well. Some courses are designed to communicate basic information and knowledge (especially to those individuals who may lack formal supply chain education) while other aspects hit on supply chain skills that can be applied on the job (such as how to achieve supply chain transformation within an organization).

"If you are managing inventory, there are tried and true ways to manage that inventory," Langley points out. "If you don't know those ways, you won't be useful as an inventory manager, plain and simple." Once an employee attains those operational skills, Langley says he or she can then play a larger role on the strategic side of supply chain management (i.e., direction setting and visioning). Ultimately, he says the companies that fill in the talent gaps on the supply chain side are those that make the commitment to ongoing education and consider that education "vital to their corporate cultures."

Assessing the Options

In 1997, Nick Vyas made the jump from industrial engineer to supply chain professional. He spent the next 16 years developing his own educational foundation and network within the supply chain field. It was a luxurious timeline that most professionals simply can't afford to work on in today's business world. "The speed of change is very fast right now," says Vyas, senior program administrator for global supply chain management at the University of Southern California. "The professionals with the skills and the training are at an advantage and able to differentiate themselves from the rest."

Achieving that goal requires a good balance between practical and theoretic knowledge, says Vyas, who points to certifications as a good option for a front-line supervisor or entry-level manager who lacks a structural education background. "As that person starts to climb the corporate ladder," says Vyas, "that's where an advanced degree and additional education will come into play." A master's degree in supply chain, for example, helps position graduates to become future vertical leaders, department heads, or organizational leaders. "If that's the plan, then spending the time to get that master's degree will definitely pay off," says Vyas.

Supply chain managers looking to get their teams up to speed while filling in talent gaps should also consider education that incorporates—or, focuses on—global supply chains. With today's supply chains reaching around the world, the professional who can think outside of the traditional domestic borders and solve problems related to foreign trade, distribution, and logistics has become increasingly valuable for organizations. "Having that understanding of the global perspective, and a related network of contacts and resources," Vyas points out, "allows the individual to tap into many of the possibilities that are not available to those who lack this exposure."

Brown Bags and Job Shadowing

Getting a team up to speed and ready to tackle the new supply chain realities should start with a skills gap assessment. The Institute for Supply Chain Management, for example, uses a gap analysis tool to figure out exactly where employee education and/or skills are falling short—rather than relying on a manager's assessment of the problem. "In many cases, the gap that the manager identifies is just a symptom of a larger, underlying problem," says Mary Lue Peck, ISM's managing director. What may look like an issue with negotiating and

contracts, for example, may actually be traced back to serious gaps in analytical and financial skills.

Once those gaps are accurately assessed, Peck says supply chain managers can use on-the-job training methods like mentoring and job shadowing (when someone works with another employee to learn a new skill, get hands-on knowledge of a different job role, etc.) to begin effectively addressing those issues. In many cases, these collaborative training techniques are a two-way street when it comes to results. "The newer employees can learn from the more experienced worker," says Peck, "and the latter can learn about technology, social media, and other 'newer' innovations from the mentee."

The human bonds that form as a result of these interactions can be invaluable according to Peck, who recently worked with a company that was putting several of its supply chain employees through the group's Certified Professional in Supply Management (CPSM) certification program. Using brown bag lunch meetings, study groups, and the related courseware, the team worked together to prepare for the certification. "They really bonded and, in this particular case, the employer's return on investment (ROI) was covered by the retention rate," says Peck. "They're now pushing the strategy out to a larger group because it makes education fun and engaging."

Enhancing Learning Capacity

To supply chain managers who understand the value of ongoing education for their team members, but who aren't sure about the best way to approach it, Peck says it pays to take a holistic view at the process. Instead of randomly sending employees out to different courses and certification programs that may or may not yield a return, for example, consider where the gaps are in both quantitative and qualitative skills and then work to fill in those chasms with pertinent, quality educational opportunities.

During this process, Michele Ralston, associate director of open enrollment at Washington University's Olin Business School in St. Louis, says companies should consider all modes of learning. With distance education gaining more ground every year, peer mentoring and tutoring still proving its effectiveness, and full-blown college programs proliferating, there's literally no end to the number of options that are at your fingertips.

"The traditional classroom is certainly important, but the value of non-degree study and certificate programs is very high and the return on investment can be very quick," Ralston says. "Programs like the one day or five day certificates and seminars can really bring immediate value back to the learning capacity and help supply chain managers hone their teams for success."

Supply Chain Education Programs

UNIVERSITIES AND EDUCATIONAL INSTITUTIONS

Arizona State University
W.P. Carey School of Business
480-965-2100
wpcarey.asu.edu

The online Certificate in Supply Chain Management is designed for busy working professionals who want to benefit from challenging, graduate-level coursework.

Course Schedules:
- Supplier Management and Negotiation, January 6 - February 9, 2014
- Logistics in the Supply Chain, February 17 - March 23, 2014
- Supply Chain Design and Cost Management, March 31 - May 4, 2014

Auburn University
334-844-4000
www.auburn.edu

Auburn's Raymond J. Harbert College of Business offers the Supply Chain Management major, which equips students to handle the complexity of the flow of goods across the global marketplace by combining logistics and operations management training and provides a practical understanding of procurement, operations, and logistics.

Brigham Young University
Marriott School
marriottschool.byu.edu

The Global Supply Chain Management major prepares students to respond to strategic and operational challenges within an organization. Students are trained to work closely within the company along every step of the production-to-sales process. Coursework includes working with the traditional areas of product design, manufacturing, marketing and sales, purchasing, logistics and distribution, as well as understanding how to maintain strong relationships with the same functional areas in customer and vendor organizations.

Cranfield University
School of Management
44-011-1234-758102
www.cranfieldmsc.biz/log

Established over 26 years ago, the University offers one-year full-time Masters in Logistics and Supply Chain Management. It is widely recognized as one of the top logistics courses in the world. Whether you are already a professional in this field or are looking to move into this area, this course provides you with the specialist knowledge and skills to further your career in supply chain management.

Georgia Institute of Technology
Executive Masters in International Logistics (EMIL)
404-385-7306
www.emil.gatech.edu

The EMIL-SCS Program helps Fortune 500 companies design creative new solutions for critical issues in their global supply chains by grooming their key executives. This unique 18-month master's program keeps key employees on-the-job while teaching them practical techniques for decreasing logistics costs and improving supply chain efficiencies.

Georgia Institute of Technology
Supply Chain and Logistics Institute (SCL)
404-894-2343
www.pe.gatech.edu/scl-scmr

The Georgia Tech Supply Chain & Logistics Institute has been the premier institution for supply chain and logistics professional education, innovation, and leadership for more than 20 years. The curriculum includes comprehensive programs in lean supply chain, transportation, warehousing, inventory, cold chain management, supply chain strategy, and health & humanitarian logistics. Also included in the curriculum are more specialized courses in a wide range of topics from supply chain management technology to warehouse layout/design.

Golden Gate University
Edward S. Ageno School of Business
415-442-6500
www.ggu.edu

Golden Gate University offers undergraduate and graduate certifications in operations and supply chain management, and concentrations and certificates for professionals who want to work in industries like high-tech manufacturing, engineering and construction, biotech, and consumer retail.

Indiana University
Kelley School of Business
877-785-4713
www.kd.iu.edu

For master's level students interested in global supply chain management, Kelley's Department of Operations and Decision Technologies has many options. Master's degree students in the department can pursue one of these majors:

Master of Business Administration (MBA) in Supply Chain and Operations

Master of Science in Global Supply Chain Management (MSGSCM), designed for the working professional and offered online)

Supply Chain Management is also offered as a minor for MBA students

Massachusetts Institute of Technology (MIT)
Center for Transportation and Logistics
617-258-7267
ctl.mit.edu

Today's companies are realizing the importance of the supply chain as a revenue generator — it's not just a cost of doing business. In order to remain competitive in the global marketplace, senior executives must completely transform their business approach and conventional supply chain practices, and embrace new capabilities that drive more value. How can you leverage the latest supply chain tools, practices, and capabilities to ensure that your company is poised to adapt in this rapidly changing environment and not be left behind? You can start by learning from the best at MIT. Programs are:

- Executive Education - Supply Chain Management: Driving Strategic Advantage
January 7, 2014 - 11:30am EST and January 10, 2014 - 3:00pm EST

Michigan State University
Broad College of Business
517-353-6381
www.bus.msu.edu/supplychain

In keeping with the vision of the Department of Supply Chain

Management to be widely acknowledged by industry and academia as the leader in dissemination of procurement, manufacturing, and logistics knowledge, Michigan State University's Supply Chain Management program integrates topics from manufacturing operations, purchasing, transportation, and physical distribution into a unified course of study.

North Carolina State University

Poole College of Management
919-515-5560
www.mgt.ncsu.edu

The Supply Chain Management MBA program involves working in multidisciplinary teams, where students develop in-depth knowledge of the entire flow of the end-to-end supply chain, from raw materials to finished products, with a special emphasis on information and supply flow throughout the process. Students develop the skills needed to write effective management reports, manage teams of workers, and make persuasive management presentations.

Northeastern University

D'Amore-McKim School of Business
617-373-3270
www.cba.neu.edu

If you are interested in elevating your knowledge of supply chain management, you will find unmatched opportunities through the Graduate Certificate in Supply Chain Management at Northeastern University. Whether you are just pursuing the field or are a working professional seeking to update your knowledge base, our focused curriculum and outstanding faculty with strengths in research and practice add up to an education that leads to success. Application for program is available online.

Northwestern University

Kellogg School of Management
847-467-7000
www.kellogg.northwestern.edu/execed

If you are a senior or mid-level manager or consultant responsible for domestic and international supply chain and logistics systems, the Supply Chain Management program is designed for you. Operations, purchasing, inventory control, and transportation managers who want to ensure smooth production with as little inventory as possible, high customer service levels, and low system-wide cost are encouraged to attend. You will also benefit from this program if you are a manager who wants to gain a deeper understanding of the role supply chains play in a company's overall business strategy.

Upcoming Sessions:
- February 16-19, 2014
- June 8-11, 2014

The Ohio State University

Fisher College of Business
614-292-0331
fisher.osu.edu/centers/scm

The Supply Chain Management Program will focus on how to implement The Global Supply Chain Forum framework. The framework is comprised of eight essential cross-functional, cross-firm business processes. Examples are provided on how they have been implemented by major corporations. The seminar listed is designed specifically for executives who are striving to achieve cross-functional integration within their organization and with key customers and suppliers:

- April 8 - 11, 2014 Ponte Vedra

Penn State University

Smeal College of Business
814-865-3435
www.smeal.psu.edu/psep

Smeal offers highly regarded supply chain programs at every educational level. For undergraduates, the college offers a bachelor's degree in Supply Chain and Information Systems. At the graduate level, the Smeal MBA Program offers a concentration in supply chain management and, together with Penn State World Campus, Smeal offers an online, 30-credit professional master's program in supply chain management. The college also offers a Ph.D. in supply chain, and Smeal's Center for Supply Chain Research and Penn State Executive Programs offer three certificate programs in supply chain management. Upcoming events include:

- March 04 - 06, 2014 Designing and Leading Competitive Supply Chains
- April 1 - 3, 2014 Achieving Supply Chain Transformation
- April 8, 2014 8:00 PM Essentials of Supply Chain Management
- May 6, 2014, 8:00 AM Supply Chain Collaboration and Alignment
- May 13, 2014, 8:00 AM Processes and Tools for Supply Chain Success

Rutgers University

Rutgers Business School
973-353-5226
www.business.rutgers.edu/scmms

Supply Chain Management is one of the strategic MBA concentrations at Rutgers Business School. The curriculum is designed by faculty with input from the Center of Supply Chain Management and its industry affiliates to ensure that it is both comprehensive and current. This program has a strong corporate sponsorship, which provides scholarships as well as excellent intern and job placement opportunities. Rutgers also offers an undergraduate major in Supply Chain Management for the Rutgers Newark and New Brunswick campuses.

Stanford University

Graduate School of Business
650-723-3341
www.gsb.stanford.edu/exed

The complexity involved in managing supply chains that span continents and dominate markets demands strategies and systems that are agile, adaptable, and aligned. The Strategies and Leadership on Supply Chains program is taught by world-renowned thought leaders in the field. This program gives you the tools you need to create and manage market-leading global supply chains.

Syracuse University

Whitman School of Management
315-443-3751
www.whitman.syr.edu/scm

Supply chain managers very often hold the key to corporate profitability. Economists and employers single out supply chain management for its strong growth potential. Home to the nation's first supply chain program (established in 1919), the school's supply chain management program is well attuned to the needs of this dynamic specialty. Whitman offers an undergraduate degree program and an MBA degree program in Supply Chain Management.

Texas A&M University

Mays Business School
979-845-1216
www.business.tamu.edu

The supply chain management major prepares students for a career in designing and managing the activities that deliver products and services to customers. This major produces graduates with strong analytical and problem-solving skills and the ability to work in and coordinate team activities. Graduates possess the business, technical, and leadership skills needed to meet the challenges of the rapidly evolving global marketplace.

The World Academy

877-265-0070
www.theworldacademy.com

The Academy provides training programs and seminars for organizations in all phases of export/import logistics, hazardous materials (HAZMAT), letters of credit, communications, harmonized tariff schedules, and INCO terms. A full list of webinars can be found on the Academy's website.

University of Arkansas

Sam M. Walton College of Business
479-575-5949
www.waltoncollege.uark.edu

Offers undergraduate and graduate programs in Supply Chain Management. Also offers the Ph.D. Program in Business Administration with an emphasis in supply chain management which prepares students for careers in research and teaching in supply chain management. Students in the program gain knowledge in the theoretical and substantive areas of supply chain management. They acquire the conceptual skills and methodological tools necessary to design and conduct independent research and interact with others in academic and business environments.

University of Denver

Daniels College of Business
303-871-3411
www.du.edu/transportation

The ITI Executive Masters Program is a fully accredited Master of Science in Intermodal Transportation Management from the University of Denver for experienced managers in the freight and passenger transportation sectors as well as the supply chain and logistics management industries.

University of Maryland

R.H. Smith College of Business
301-405-2189
www.rhsmith.umd.edu

Whether you're a recent graduate with an interest in how goods move around the globe, or a manager who would like to broaden your understanding of the global supply chain, the Smith MSB in Supply Chain Management will help you develop strong managerial skills and make connections with supply chain executives from a cross-section of industries. You'll be prepared to lead innovation that drives business growth, promotes efficiency, and helps sustain the planet - and gain the relevant, real-world experience most sought after by recruiters.

University of Michigan

Ross School of Business
734-763-5796
execed.bus.umich.edu

Students in our Ross School's Master of Supply Chain Management Program (MSCM), learn from Ross' world-renowned faculty in operations and management science, as well as top-ranked researchers in all business disciplines. MSCM students are admitted to the Tauber Institute for Global Operations, a partnership between the Ross School and U-M's College of Engineering.

University of San Diego

Supply Chain Management Institute
619-260-4894
www.sandiego.edu/scmi

The Supply Chain Management Institute Helps achieve more cohesive supply chain management business acumen among students, faculty, and industry. USD's Supply Chain Management Institute is wholly invested in supporting USD's mission to develop more globally minded, responsible leaders. We regularly research and update the curriculum and create advanced learning opportunities to help students gain relevant supply chain management knowledge that is aligned with industry needs.

University of San Francisco

415-422-5555
www.usanfranonline.com/ism

USF offers e-learning in three 8-week courses for the Advanced Professional Supply Chain Management Certificate program and the Advanced Professional Sustainable Supply Chain Certificate program.

University of Tennessee

College of Business Administration
865-974-5001
supplychain.utk.edu

To earn your Supply Chain Management Certification you must complete our Global Supply Chain Executive Development program and our Demand Management in the Supply Chain program along with three additional 2.5-day programs from the supply chain program listing. The Supply Chain Management Knowledge Assessments follow each program. Courses may be taken in any sequence and will be offered at least once each year. There is no time limit for completing the certification.

University of Wisconsin-Madison

Executive Education Center
608-262-1500
exed.wisc.edu/supplychain

The Grainger Center for Supply Chain Management is one of the only endowed, university-based centers specializing in lifelong education in supply chain management in the United States. Its unique curriculum is cross-functional and takes an integrated business process view of supply chains, including marketing, sourcing, logistics, operations, and customer service. It is a personalized, industry-focused program supported by companies known for supply chain excellence. Students connect with and learn from real-world supply chain leaders and are part of a strong, close-knit community.

Walden University

866-492-5336
www.waldenu.edu

The University offers several courses in Supply Chain Management in Executive Education including Project and Process Management, Business Operations, and Purchasing and Supply Management.

PROFESSIONAL ASSOCIATIONS

APICS

800-444-2742 **www.apics.org**

APICS is the leading professional association for supply chain and operations management and the premier provider of research, education, and certification programs that elevate supply chain excellence, innovation, and resilience. APICS Certified in Production and Inventory Management (CPIM) and APICS Certified Supply Chain Professional (CSCP) designations set the industry standard. Global event is as follows:

APICS 2014 Shanghai, April 17-18, 2014, Shanghai, China
InterContinental Shanghai

CSCMP (Council of Supply Chain Management Professionals)

630-574-0985 **cscmp.org**

CSCMP's global conference brings together thousands of supply chain professionals from all over the world to exchange ideas and share knowledge. Also conducts local roundtables across the country and the globe and offers a variety of supply chain webinars. CSCMP's Online University offers members and potential members easy access to the latest in logistics and supply chain management.

ISM (Institute for Supply Management)

480-752-6276 **www.ism.ws**

ISM offers certification programs, seminars, professional development services, and online courses for the supply management professional. It also features an annual Conference and Educational Exhibit. Conference events:

ISM Supply Chain Diversity Summit
February 26 - 28, 2014, San Francisco, California

CPO in the Making, April 8-10, 2014
Tempe, AZ

ISM 2014 International Supply Management Conference, May 5-7, 2014
Las Vegas, NV

NITL (National Industrial Transportation League)

703-524-5011 **www.nitl.org**

The League represents shippers in their dealings with various regulatory bodies. Provides educational forums, annual conferences, webinars, and industry exhibitions through an annual TransComp event.

SIG (Sourcing Interests Group)

530- 582-8600 **www.sourcinginterests.org**

SIG provides summits, global regional conferences, and web-based learning to enable members to network and build relationships.

Supply Chain Council

202-962-0440 **sig.org**

Through the Supply Chain World conference, the Council provides a forum for supply chain and business executives to identify opportunities to improve financial and supply chain performance. Presents a benchmarking database by which companies can compare their supply chain performance to others; also offers training in the SCOR model. Events scheduled:

- Symposium – Minneapolis, Minnesota, February 5, 2014
- Roundtable- Hartford, Connecticut, March 24, 2014
- Global Sourcing Summit – Nashville, Tennessee, April 1-3, 2014

TRB (Transportation Research Board)

202-334-2934 **www.trb.org**

TRB is one of six major divisions of the National Research Council. This agency offers conferences, workshops, research, and e-sessions for the transportation community.

VICS (merged with GS1 US)

609- 620-0200 **www.vics.org**

GS1 US launched the Initiative upon the merger with the Voluntary Interindustry Commerce Solutions (VICS) in 2012. Today more than 100 suppliers, distributors, retailers, and logistics providers are participating members in Initiative activities, focused on improving inventory accuracy, exchanging standardized product data, and achieving traceability with GS1 Standards. The GS1 US EPC Item Level Readiness Program provides education through web and teleconference-based sessions with topics ranging from understanding the value of EPC-enabled RFID and proper deployment of the technology to meeting the requirements of your trading partners.

WERC (Warehousing Education & Research Council)

630-990-0001 **www.werc.org**

WERC is a professional organization focused on warehouse management and its role in the supply chain. WERC offers seminar, conference sessions, e-learning opportunities, and webcasts.

PRIVATE FIRMS

Accenture Academy

www.supplychainacademy.com

The Accenture Academy supply chain curriculum offers hundreds of courses covering supply chain fundamentals, product innovation and lifecycle management, supply chain planning, sourcing and procurement, manufacturing, logistics, and customer and service management. We integrate these supply chain-specific courses with the specialty skills and broader business management capabilities needed to help the supply chain workforce become more versatile business professionals.

"My Elmhurst graduate degree opened doors for me. I've had several promotions since I graduated and calls from recruiters, who look to Elmhurst for supply chain professionals. They know the program is top notch."

Tim Engstrom
VP Supply Chain Operations
Walgreen Co.

Connect the world

WITH ELMHURST'S M.S. IN SUPPLY CHAIN MANAGEMENT

A well-functioning supply chain is the key to a successful business. To understand the operating practices of a company, you need to understand it from end to end. Elmhurst's master of science in supply chain management gives you expertise in analyzing operations, understanding logistics and transportation, making sound decisions, and motivating people. This two-year, evening program is the first and longest running of its kind in the metro Chicago area. The program is also offered at the University Center of Lake County in Grayslake, Illinois.

Graduate Information Session
Tuesday, January 14, 6:00 p.m.
Frick Center, Founders Lounge
Elmhurst College

Reserve your space and learn more
Visit: elmhurst.edu/chooseElmhurst
Call: (630) 617-3300
Email: sps@elmhurst.edu
Learn more: elmhurst.edu/scm

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twitter.com/SPSelmhurst

Meeting you where you are.
Taking you where you want to go.

Elmhurst College
SCHOOL FOR PROFESSIONAL STUDIES