

**Proceedings of the Supply Chain 2020 Project's
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Supply Chain 2020 Project Background

The Supply Chain 2020 (SC2020) Project is a multiyear research effort to identify and analyze the factors that are critical to the success of future supply chains. This pioneering project will map out the process innovations that will underpin successful supply chains out to the year 2020.

Initiated by the MIT-Zaragoza International Logistics Program, the global research project involves dozens of faculty, research staff, and students at MIT and other institutions around the world. Two advisory councils, the Industry Advisory Council (IAC) and the European Advisory Council (EAC), made up of supply chain executives from leading companies, are playing a crucial role in helping to shape the work and generate new ideas.

By looking farther into the future than most business research initiatives, the SC2020 project hopes to deliver practical advances on the design and management of future supply chains. The project also aims to help companies understand the forces that are changing supply chains so that they can be better prepared for the future. This work can create value in society through improvements in transportation, logistics, and supply chain management (SCM) practices.

SC2020 research is broad and far-reaching, and is designed to meet a series of objectives in several phases. The objective of Phase I was to understand excellent supply chains and the underlying strategies, practices, and macro forces that drive them. Leveraging what was learned during the first phase, Phase II and later phases of the research are identifying underlying principles and projecting the future using scenario generation and planning methodologies.

As well as leading to a better understanding of future successes in supply chain management, the work will highlight what actions organizations should take to help ensure supply chain success. The work will also identify "sensors in the ground" -- approaches to recognizing which of the many possible futures are occurring. Forethought about the future will help companies position themselves for the long-term and avoid ill-conceived emotional responses to future changes in the world.

The Q4 2005 semi-annual meeting of the IAC was held on November 30th at The Hotel@MIT to solicit insights from the corporate supply chain executives. The meeting was held the morning after a symposium titled "Building the Future Supply Chain Now," which was attended by CTL sponsoring companies as well as IAC members. The meeting had the following agenda:

1. Re-cap of the "Building the Future Supply Chain Now" Symposium (Larry Lapide and Mahender Singh - MIT)
2. Supply Chain Response to Environmental Issues (Randy Kirchain - MIT)
3. Supply Chain Principles Research (Larry Lapide - MIT)

Project Progress and Future Plans

The SC2020 is a three-phase project that is now in its second phase. The first phase, completed during the 2004-2005 academic year, focused on researching excellent supply chains to understand the linkages among their strategies, operating models, objectives, practices, and principles being leveraged. It included research into 21 case studies of supply chains in nine different industries, as well as a survey of 25 studies that analyzed the causal linkage between supply chain management and firm performance.

Phase II, currently ongoing, has three parts that include the creation of macro-factor scenarios, the development of supply chain models, and the completion of the supply chain principles research. This work will help uncover how changing macro factors and an underlying set of core principles will drive supply chain practices in the future.

The final phase, Phase III of the research plan (for the 2006-2007 academic year), will bring all of the work together to determine how companies might respond to future changes and how companies can prepare for those possible futures.

Council Reactions to the *Building the Future Supply Chain Now* Symposium

Council members discussed their reactions to the previous day's sessions.

SC2020 Scenario Planning

Council members debated scenario planning approaches for the SC2020 project. Some argued for leveraging the UPS scenarios directly. Others argued that the UPS scenarios, while good for UPS, weren't perfectly suited for the goals of SC2020. In particular, the broader supply chain focus of the project means that the SC2020 project needs scenarios that focus on dimensions which are different from those incorporated into the UPS scenarios. In particular, the SC2020 scenarios need to emphasize the relative roles of efficiency, asset utilization, and customer expectations to supply chain and company performance. These scenarios could be segmented by geographic region, industry, and company context.

Council members also advocated for more actionability around the scenarios. Specifically, this might include more role-playing to understand each scenario, further documenting key macro factors, and paying more attention to the numerous variables that each member company might track. Different companies will give different weights to different variables, which will impact the actions that a given company will take. A deeper understanding of the key macro factors that impact different scenarios will help individual member companies relate these distant futures to mid-term (3-5 year) actions in their specific company.

Several members wanted to intensify but shorten the scenario planning phase of the project. The original project plan included surveys and a 6-month effort to create scenarios appropriate to the needs of the SC2020 project. Some members wanted to de-emphasize scenario generation and instead spend more time in the near future on understanding the implications of the scenarios. These members wished to take a more active, participatory role to both support the effort and to help themselves understand how different scenarios might impact their companies.

Demographics

Council members saw both opportunities and challenges in the demographic shifts described by MIT's Dr. Joseph Coughlin the previous day. Some members worried about impending mass retirements – their companies' rapid growth during the 1960s and 70s created a "pig-in-the-python" bulge in the demographics of their companies' workforces. Older workers represent a valuable asset that will be lost when they retire. The companies are considering how to mitigate the effects of this loss.

Some members saw retirees as a potential resource, because the studies showed that retirees don't stop working. Rather, they change careers or work part time. This suggests that retirees don't have to disappear. Council members wondered about various post-retirement roles for older workers. Could companies bring back retirees as part-time consultants? Could they hire the retirees of competitors to gain outside wisdom? Could companies look to older workers, especially older women, as trust-building customer service agents?

An aging workforce poses special challenges to physically-demanding jobs common in the supply chain. It's not clear how companies can handle the gap between the need for blue collar work in the U.S. versus the availability of blue collar labor in countries such as Indonesia. Older workers might be able to do some of these jobs, if partial automation or augmentation reduced the physical demands of the job.

Nature of Work

The aging boomer population will affect the workforce; the changing expectations and abilities of younger workers will affect it as well. Young workers are very comfortable using technology, which represents a further opportunity for automation. Many supply chain jobs are blue collar jobs that the youth of the developed world disdain. Other companies face issues of employees of all types who want a better work-life balance. Automation could be used to address both of these issues.

For example, companies currently have difficulty finding truck drivers and warehouse workers. Turnover for long-haul truck drivers can be 140%. Some council members are now implementing family-friendly policies that they would have never considered 10 years ago. These include figure-8 route designs for long-hauls, 4x10 work weeks, and family-friendly relocation policies to enable workers to move in order to care for aging parents.

Supply Chain Response to Environmental Issues

Environmental and economic issues affect material selection, design, and manufacturing. The rise of Green Laws in both the developed and developing countries motivate changes in both product and package design for recyclability and minimized environmental impact. Currently, regions such as Europe, California, Canada, and the Northeast U.S have Green Laws. Japan, China, and India are considering them. As more countries enact regulations, companies have a greater incentive to create global 'green policies'. Companies' increasing environmental sensitivity, by regulation or by choice, is one facet of the SC2020 project being researched by Prof. Randy Kirchain. He and the council members discussed this issue at the IAC meeting.

Drivers

In addition to government regulation, other factors motivate companies toward environmentally friendly policies and products, according to Prof. Kirchain. Small but growing demand for green products encourages companies to add that as a feature of their products and services. Increased oversight by the media and other Non-Governmental Organizations (NGO) pressures companies toward better behavior. Concern for scarce natural resources -- and rising prices for those resources -- encourages conservation.

Members described other motivators for "green" policies and products. For example, environmental credit systems represent a carrot in contrast to the stick of regulation and public embarrassment. One member company buys copious amounts of "green" electricity, thus garnering "carbon credits," and it is considering selling these credits to its customers.

Companies track the contents and sources of materials for safety and reliability. Maintaining high quality in industries ranging from food products to automobile manufacturing means tracking supplier sources, tracing potential contaminants or defects, and enabling product recalls if needed.

Some companies also face indirect pressure from dominant business partners in the supply chain. For example, Wal-Mart's initiatives to reduce solid waste at its stores mean new mandates for the retailer's broad network of suppliers.

End-of-Life Logistics

End-of-life (EOL) disposal affects supply chains, because it places new reverse logistics requirements on companies. This includes companies that make products subject to the new rules, such as consumer electronics makers, as well as the companies that use these products. For example, one member company is now looking into disposal issues for the information technology products that are widely used at the company. Concerns about lead-based solder and other toxic materials (such as those found in batteries) create a challenge.

EOL disposal offers an opportunity, not just a challenge. For example, cellphone makers actually profit from recycling efforts by extracting valuable metals from old phones. One member company noted that a new product delivery is the perfect opportunity to take back an

old obsolete product -- the driver is at the customer site already and the return journey would otherwise be empty.

Companies respond differently to EOL regulation, according to Prof. Kirchain's research. For example, HP created its own independent operation to handle end-of-life products, and it embedded an invisible fee in its products to cover the costs. In contrast, Philips created a collective system with other manufacturers that relies on a visible "deposit" fee. These two strategies epitomize the American individualist versus the European collectivist approach to solving problems. On the one hand, HP sees EOL as a potential differentiator and source of the company's own competitive advantage. On the other hand, Philips sees EOL in terms of the company's shared responsibility to contribute to a societal solution.

Global Environmental Standards

Many member companies reported using global standards for environmental responsibility. These are drawn from the most restrictive set of regulations. In many cases, it's easier to implement stringent, highest-common-denominator guidelines worldwide rather than to allow a patchwork of lax policies in locations which don't have strict regulations. By implementing a single global standard, companies enable interchangeable people, processes, and products. At the same time, they avoid the risks of failing to keep up with the laws of a thousand jurisdictions. Large companies with highly public brands face greater risks of embarrassment at environmental lapses, which tends to make them take these issues more seriously than smaller firms do.

Council members did, however, mention exceptions to universal application of stringent global policies. Extreme cost consciousness by some customers forces companies to cut corners where they can. The local workforce also impacts compliance, in the sense that companies know that if they tried to enforce all their usual policies, the workers might leave. In some countries, U.S. companies have lobbied for more stringent regulations to help compete against environmentally lax local companies.

The Role of Information

Several of the members alluded to the increased role of information in achieving environmental goals. This includes tracking the sources of materials, the locations of items subject to EOL disposal regulations, and reverse logistics operations. This is a new function for traditional waste handlers who, in the past, did not track what they handled. Information would also contribute toward other goals, such as tracking the impact of chemicals on workers and consumers, or tracking outcomes from prescription medications.

The information about environmental attributes of products can even be a source of competitive advantage. One member company tracks the percentage of post-consumer recycled materials in the products sold to its customers. This allows the company to give customers information that supports the customers' goals for using recycled materials. The valuable information provides an incentive for customers to only buy from that company.

Supply Chain Principles Research

Phase I of the SC2020 project included research on current excellent supply chains and best practices. As the project progresses, the researchers are using the findings to uncover the principles that underlie today's best practices. The goal is to move beyond a laundry list of best practices toward a series of time-independent underlying principles. The result is a mapping from each best practice to the underlying business operating principle and from the business operating principle to the underlying fundamental principle.

Segmentation

For example, Limited Brands segments its supply chain that moves both fashion-oriented goods and more basic, timeless goods. The best practice is the use of premium air freight for fashion goods and low-cost ocean shipping for other goods. The underlying operating principle is the *trade-off between the costs of cycle-times and holding inventories*. Underlying the operating principle is the more fundamental principle of Little's Law that relates queue length and waiting time.

Several of the council companies segment their supply chains in some way. Examples include segmenting between strategic and pure-price buyers, customer profitability, feature-based versus value-based products, and delivery/response-time requirements. These segments then drive the portfolio of services and the level of services provided to each segment.

Constraint Relaxation of Time

In a second example, Cisco has a best practice in Service Window Management. Cisco quotes a lead time of 21 days, even though the company could largely deliver in 10 to 15 days. This is an example of the *constraint relaxation* principle. Amazon also uses this practice with its low-cost shipping options by quoting a longer shipping time than needed. Constraint relaxation gives companies such as Cisco and Amazon the freedom to consolidate orders, level loads, and optimize supporting processes. *Constraint relaxation* exemplifies the fundamental principle that tighter constraints can never result in a better objective function.

Council members discussed constraint relaxation. For example, one member found that relaxing delivery lead-times from two days to four days caused no problems for the company's customers or its competitive position. Another member is avoiding constraint relaxation because, for his company, longer (less-constrained) lead times equal less demand. The company is even looking toward tighter one-hour delivery windows. Only 30% of B2C deliveries occur on the first try, which has two negative effects: higher delivery costs and lower customer satisfaction. More tightly-constrained one-hour delivery windows would alleviate these problems. Other members mentioned contexts that don't permit constraint relaxation, such as Army logistics delivering critical supplies to warfighters.

Constraint Relaxation of Capacity

Companies use other best practices to implement the operating principle of *constraint relaxation*. Toyota uses excess capacity and partial work-shifts in addition to inventory, in order to handle variability. Toyota can run 2.5 shifts to effectively relax capacity constraints.

Council members employ similar measures. For example, one member has an annual cycle of hiring a mass of temporary workers to help it cope with a 40% boost in volume between Thanksgiving and Christmas. Other companies create flexibility by cross-training employees to handle multiple tasks, designing factories to flexibly produce a wider range of products, and using platform product designs that allow for multiple product lines built on a single core design. The point is that fungible capacity relaxes constraints.

Sphere of Influence

Wal-Mart's long-standing practice of sharing of POS (point of sale) data represents a different set of principles. Sharing the data extends the retailer's sphere of influence. The data helps its suppliers understand Wal-Mart and Wal-Mart's pattern of demand better. *Sphere of influence* is the operating principle, and it, in turn, is an example of the fundamental principle that optimizing the parts of a system is never better than optimizing the whole. Sharing data helps optimize Wal-Mart's entire supply chain.

Council members extend their sphere of influence through a variety of mechanisms. Some members use three-way purchasing: buying strategic raw materials on behalf of suppliers to both control upstream supplies and ensure supply time. Others see less opportunity for data sharing for two reasons. First, the data is only useful to the extent that the supplier understands the implications on future demand. Thus, improving the quality of the forecast by involving more parties in the planning stages, rather than merely sharing data, is a better way to extend influence and optimize larger segments of the supply chain. The second limitation of data-sharing occurs when extremely long lead times mean that near-term demand signals provide little useful guidance. In that situation, one member uses postponement.

Multi-Faceted Example: Dell

The preceding examples of specific practices from specific companies only touch the surface of what makes each of these companies an example of a successful supply chain. Companies use multiple practices in combination. Thus, real companies exemplify multiple operating principles and fundamental principles.

For example, three of Dell's practices include "inbound transportation collaboration," "consigned supplier inventory hubs," and "demand shaping." Each practice leverages one or more of the operating principles of *economies of scale*, *sphere of influence*, *supply contracts*, and *demand-supply matching*. In turn, the fundamental principles are the *Power Curve* and the fact that *optimizing the parts is never better than optimizing the whole*. Dell uses timely demand information to optimize supply and guide inbound transportation. Dell also uses timely supply information to shape demand.

Numerous council companies use these principles. Some companies use demand-supply matching, especially discounting, to adjust the flow of product. A few companies even raise prices on hot products. Yet it means different things to different companies. Whereas Dell can manage demand with an instantaneous adjustment to a webpage, other companies can only manage demand through more laborious communications with a salesforce.

Some members cautioned about the value of real-time visibility such as that which Dell uses to run its business. Sometimes too much real-time information feeds manic-depressive

overreactions. Companies need to map through processes, understand reaction times, and craft a level of visibility and flexibility that is right for each part of their business.

Leveraging Principles for the Future

The preceding examples are just a fraction of the best practices, operating principles, and fundamental principles identified by the SC2020 research effort. To date, the project has identified 21 operating principles and seven fundamental principles. These principles form the basis for how companies might operate supply chains in the future. As the project moves forward, the researchers and companies can use the principles and practices as building blocks for future supply chain innovations.