Proceedings of the Supply Chain 2020 Project's European Advisory Council Fall 2005 Meeting

Held by the MIT Center for Transportation & Logistics

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1. 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 innovations that 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 breakthroughs 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 is 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 Fall 2005 (and 3rd semi-annual) meeting of the EAC was held on 18 October 2005 at the Deutsche Post International Mail Center at the Frankfurt Germany Airport to solicit insights from the corporate supply chain executives. Faculty from the Zaragoza Logistics Center (ZLC) were also in attendance to provide additional insights. The meeting was moderated by Larry Lapide and was supplemented with an optional tour of the international mail facilities. The meeting had the following agenda:

1. Zaragoza Logistics Center Update (Prashant Yadav - ZLC)
2. SC2020 Phase I Update and Principles (Larry Lapide - MIT)
3. Supply Chain Response to Green Laws (Randy Kirchain - MIT)
4. Supply Chain Response to Macro Factors (Mahender Singh - MIT)

2. Project Update

The update of the project covered research findings from Phase I of the SC2020 project --- completed in June 2005, the conclusion of the 2004-2005 academic year. The findings supported the hypothesized linkages needed by an excellent supply chain. Namely that it must:

- Support, enhance and be an integral part of the business strategy
- Leverage a complementary operating model to sustain competitiveness
- Execute well against a balanced and competitive set of operational performance objectives
- Focus on a few reinforcing 'tailored' business practices that are aligned to meet the competitive performance objectives

Council member input about this suggested that we need to make sure we understand how an established supply chain aligns to become excellent versus a new company such as Dell that can start from scratch. The latter startups do it using a new business model, but an established company has limited opportunities to start anew. Phase I research included some of this as it compared hundred year old companies like IBM and Lucent to startups, Dell and Cisco Systems, respectively. Both IBM and Lucent have had to evolve their supply chains over a long period of time as business conditions changed.

In addition, one Council member pointed out that our operational performance objectives model appears to be company rather than total supply chain-centric. Perhaps we should think more about extended supply chain operational performance and related metrics. These would apply to a whole supply chain.

The update of the project also discussed three parts to Phase II of the research to be conducted during the 2005-2006 academic year. Phase II.A will develop several future scenarios comprised of a consistent set of relevant macro factors that are expected to impact future supply chains in 2020. Phase II.B will pilot and try out approaches to modeling the linkages among supply chains and these macro factors in a couple of industries. The third part, Phase II.C, will extend the research findings on excellent supply chains from Phase I of the project. This part will identify the basic underlying principles behind today's tailored and often-called best practices, in order to project how companies will leverage principles to innovate new tailored practices as macro factor changes dictate.

Lastly the update also covered the research plan for the 2006-2007 academic year in which the project 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.

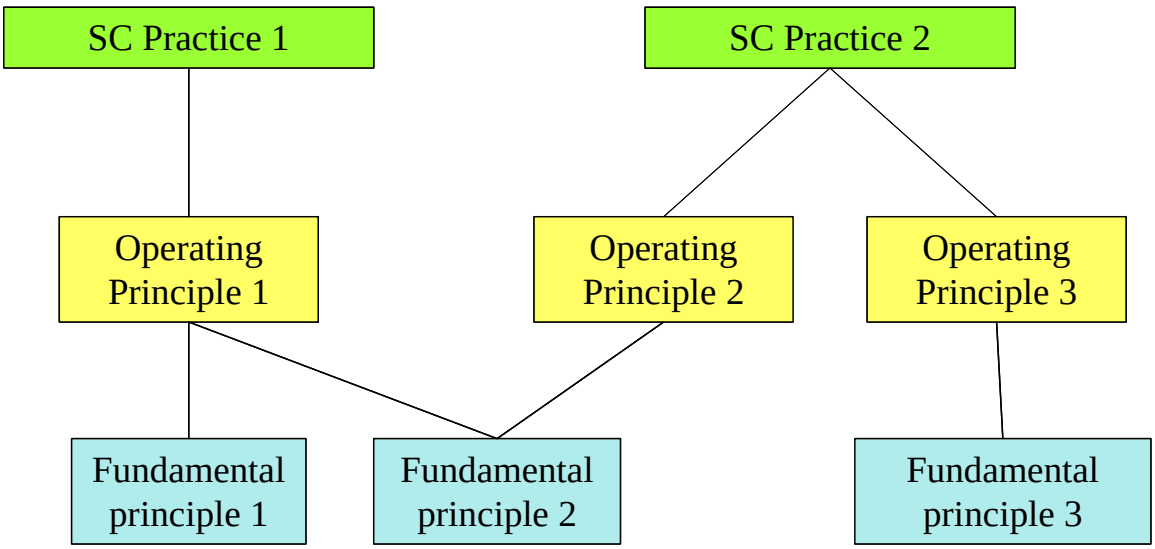
3. Supply Chain Principles

3.1 Principles Framework

"Beyond best practices" is the unifying theme behind the research to be conducted on identifying supply chain principles during Phase II. It is predicated on the fact that a practice may be best for the supply chain of a specific company trying to achieve competitive advantage, but it may not be best for another company in another industry, nor even in its own. Moreover, a so-called best practice today may not be best for that same company in the future since its business strategy and environment may change. So-called best practices are such because the early adopters of integrative supply chain management concepts succeeded with these practices and others, especially industry consultants, termed them 'best'.

We believe that best practices produce superior results by virtue of leveraging a key set of fundamental principles. Phase II plans include the identification of up to several dozen operating principles that can be leveraged in all future practices of successful supply chains. In addition (it is postulated) that from seven to ten fundamental principles underlie these operating principles. (See Figure 1 that depicts the project's working Supply Chain Principles Framework.)

Figure 1: Supply Chain Principles Framework



3.2 Principles Illustrations

The EAC discussion on supply chain principles started off with two examples to illustrate the relationship among practices and principles. The first profiled the LimitedBrands

business practice of leveraging two supply chains - one used to distribute its fashion items and the other used for its basic items. The major difference is that basic items are routinely shipped over the water from Asian plants into the U.S. market, while air freight is heavily used for fashion items. The company follows the practice of segmenting its supply chain into a responsive supply chain to handle its fashion items and an efficient supply chain for its basic items.

The practice leverages an operating principle that involves the relationship of cycle time versus inventory costs -- while underlying the operating principle is a fundamental principle called Little's Law, which relates the length of a queue to its waiting time. The rationale behind the practice is that the cost of holding fashion items for about a month on a ship includes heavy obsolescence costs, since these items are usually high-margin and can drastically lose their fashion appeal during this long period of time. It is better to have fashion items on the retail shelf as soon and as long as possible. In addition, the extra month, if necessary, is better spent during the design and development cycle rather than the distribution cycle. With basic items, that typically sell at higher volumes and over a long period of time, the holding costs of ocean-based transit inventory is a small fraction of the expense of air freighting these items into the U.S. market.

Another example discussed the service window management practices used by Cisco Systems and Amazon. In Cisco's case, it quotes all customer orders with a promised delivery time of 21days, even though it could actually fulfill the lion's share of orders within 10 to 15 days. Amazon allows its web-based customers to choose among different bands of delivery times, e.g., next-day, 3-5 days, and 5-9 days; even though it can deliver most orders on the low-end of these bands using their parcel service provider.

Both these companies (interestingly in vastly different industries) are relaxing customer expectations in order to ensure that delivery commitments are met, optimally. The business practice leverages an operating principle of 'constraint relaxation' that takes advantage of a fundamental principle that 'tighter constraints can't result in a better objective function'.

3.3 Discussions

In reaction to the discussion of best practices and principles, Council members agreed that best practices are less useful to them in improving their supply chain. For example, the practices of Dell and all the product options that it offers to its customers are impractical in the food business. Food manufacturers struggle with having to provide various packaging options for something as simple as soup. It makes the supply chain too complex for them to cope with. One answer is to use contract manufacturers, but this gets expensive in such a low margin business. What is needed is an understanding of best practices or even best principles based on their applicability across supply chains and industries that have similar characteristics.

A major part of the discussion had Council members reacting to the LimitedBrands, Amazon and Cisco illustrations presented. Regarding the service window management practices, delivery time is important in all industries but often times it is virtually dictated by customers with little flexibility. There is less opportunity to offer relaxed or differentiated

delivery times. So many industries don't offer segmented delivery services with pricing differences. Some points made around this included:

- In the consumer electronics business, customers are demanding ever shortening delivery times and this makes it impossible to segment customers by delivery needs. Delivery time becomes the competitive differentiator, and so a company in this industry just services all customers the same -- basically as-soon-as-possible. This is in contrast to Cisco that can relax their delivery times because it doesn't view delivery as a competitive differentiator. Cisco largely competes on offering the most innovative technologies.
- In the grocer supply chain the big customers demand the shorter delivery times yet want the biggest discounts. This would be OK if they would take delivery in full pallets, but they don't always do so. On the other hand, the small customers get little discounts and the slowest delivery.
- Generally it is difficult for a supplier to negotiate on delivery times with customers. It greatly depends upon the balance of power between the supplier and customer. For heavily branded products a supplier might be able to do it; but certainly not for private labeled products.
- One council member said they looked into offering differentiated services but they failed at doing the requisite ABC analysis to understand the true cost of servicing each customer. Other members agreed that it is hard to get a handle on these costs and so it is just easier to offer the same service for all or just satisfy the 'squeaky wheel' customers with better service than the rest.
- One can try to offer differentiated services by regions of the world. However, often global suppliers need to set a global standard for delivery, especially for global customers.
- One company tried to offer various delivery plans but its customers, accustomed to having the delivery cost bundled into the product price, just picked up orders rather than have their goods delivered by the supplier's carrier.

The discussion then moved on to the concept of segmentation as a business practice. A telecommunications member stated that products in that industry vary widely -- from ones that sell just a few to ones that sell up to a hundred thousand; other products need to be integrated into a total system before shipment. Trying to fulfill orders with one supply chain is difficult so some supply chain segmentation is needed. For example, some of their contract manufacturers specialize in products that need to be integrated into systems before shipment, others just ship standalone products. However, generally it is hard to figure out how many policies should be followed.

One chemical company member that uses a one-size-fits-all strategy believes segmentation on delivery is possible and is evaluating the concept right now. Other members pointed out that supply chain segmentation is just hard, so most don't do it. Sometimes it is just not economical. Some council members do segment in the following ways:

- In the food business, distribution is segmented by whether or not food items have to be refrigerated and by differences in the way they are handled.
- In the pharmaceutical business since the distribution channels for all products are the same the supply chains are not segmented, except for products that have a 5 day shelf life.
- In the apparel business a company like Zara will produce the first production runs of fashion goods in low-cost, off-shore manufacturing plants prior to the selling season. As the selling season progresses and sales results come in, it will produce in higher-cost manufacturing plants nearer to its markets to shorten the time to market -- trading off higher production costs for speed to store.

An important closing point about segmentation talked about a best practice as actually having the ability to assess over time when a change is really needed. This requires a good knowledge of the whole product portfolio over time. A segmentation policy also needs to be heavily driven by the value to the customer, not only by the economics of internal operations.

Generally Council members supported the concept of research into identifying supply chain principles that can be used to innovate economical business practices in the future across industries. However, once principles are established the research should develop prescriptive methods for implementation.

4. The Supply Chain and Green Laws

4.1 Background

The MIT Supply Chain 2020 Project has undertaken an investigation of the impact of emerging environmental regulations on the operation and performance of a state-of-the-art supply chain. The goal of this work is to support general scenario planning efforts within SC2020; in particular, this work aims to answer the questions:

- How are environmental regulations evolving?
- How do environmental regulations effect supply chains and supply chain decision-makers?
- How can a firm position their supply chain to be resilient to pending changes in this domain?

4.1.a Phase I

Over the last 12 months, the SC2020 project on Environmental Regulations has taken the following three-pronged approach to research:

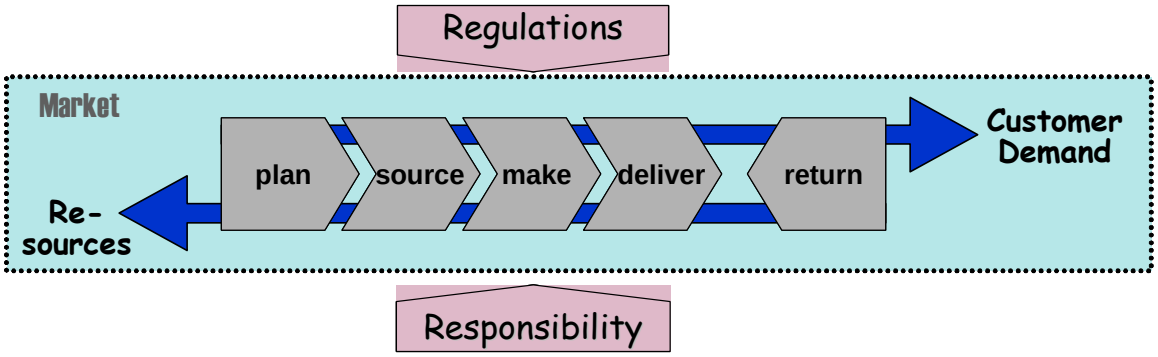
1. Survey of the literature concerning the interaction of the supply-chain and environmental regulation. Specifically, with regard to how regulation changes decision-making
2. Phone survey of supply-chain decision-makers from disparate industries
3. Detailed surveys of supply-chain decision-makers within the micro-electronics industry confronting the impact of waste electrical and electronic equipment (WEEE) legislation

Detailed results from these inquiries can be found in a whitepaper and Master's thesis, both done in support of the SC2020 Project during Phase I of the project.

A critically important finding which emerged from the broad phone survey (See Figure 2 below), was that supply chain decision-makers who are charged with addressing environmental issues see regulation as only one form of environmentally-motivated pressure to which they must respond. As characterized in the Figure 2, survey respondents identified three additional, distinct environmentally-motivated pressures. In particular, supply chains may be altered in response to changes in:

- Customer demand
- Availability of raw materials (resources)
- External or internal pressure for corporate responsibility, as well as
- Regulation

Figure 2: Environmentally-Motivated Pressures



A clear finding from the detailed electronics-industry survey was that there are currently a broad range of strategies being pursued by various firms in ending the lives of their

products. For example, two firms, both of whom sell consumer electronics, are pursuing the opposing strategies outlined in the Figure 3 below for their end-of-life supply chains.

Figure 3: Two opposing end-of-life strategies

Firm 1	Firm 2
– Joined non-competitors to form independent system ERP – Uses two centralized logistics and processing providers – Favors invisible fees	– Joins competitors in collective system – Uses local, price-competitive logistics and processing providers – Favors visible fee

Of particular note, Firm1 is pursuing in-house organization and processing, while Firm 2 intends to rely on outside contractors.

4.1.b Phase II

Beginning in the Fall of 2005 the project on Environmental Regulation will broaden its research efforts in three ways:

1. Address a broader set of industries
2. Catalog regulation which can affect specific supply chain activities
3. Develop hypothetical supply chain case models to exploring the impact of changing laws.

4.2 Feedback from Council members

4.2.a. Elements of research scope

A key purpose of the Fall 2005 meeting was to get input from EAC members on key elements of scope. First of all, several council members reiterated the impact of growing pressure for corporate sustainability efforts and the impact that these have on supply chain operations. With regard to environmental regulation, council members suggested awareness of three types of regulatory dynamics:

1. **Material content policy**

a. EU Restriction on Hazardous Substances (RoHS) implementation occurs in 2006 and continues to effect electronics supply chains and the IT infrastructure which supports them.

b. The pending EU regulation, Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) -- will extend the set of chemicals which are monitored and controlled as well as impact a broader set of industries than RoHS.

2. **Take-back Policy**

a. Implementation of WEEE legislation in the EU continues to become more complicated and costly as additional member states enact differing policy approaches.

b. End-of-life policies for electronics, automobiles, and packaging are being re-examined for possible inclusion in a super-bill. This bill may also impose take-back constraints on a number of other industries.

3. **Food Safety:** Food safety laws, much like material content laws, continue to become stricter. Such regulations require intense investment in supply chain monitoring and information exchange mechanism between stakeholders (e.g., the mad cow scare in the U.K.).

These suggestions are currently being incorporated into the 2005-2006 academic year research plans.

4.2.b Miscellaneous member feedback

In addition to comments on research scope, EAC members made the following observations:

- The Nike 'sweatshop' issues demonstrate that social responsibility goes beyond enforced regulations. A company has to consider non-regulatory organizations as well in their environmental policies. For example, companies have to protect their brand images among a more socially-conscious consumer base to avoid impacting sales, as well as other stakeholders, such as European banks to facilitate adequate financing. A company with a brand name is often the target for non-legal organizations with social agendas and in this regard, a great brand can become a liability.

- Not only is a company being watched on these issues, so are its suppliers. OEMs need to keep track of their suppliers as well as keep them abreast of their policy standards. Suppliers, in turn, need to understand their customers' position relative to environmental policies.

- Global companies have to abide by a multitude of regional and country-based regulations. One member stated that his company sets just one standard policy, so that it meets all the local regulations on a worldwide basis. In addition global

companies need to set up a monitoring system for keeping track of all the environmental issues that might emerge, worldwide.

- As end-of-life laws become more prevalent on a worldwide basis, one member predicted that the recycling of scare materials will become a more profitable business in industrialized nations. This is because scare raw materials in discarded products are often drawn from underdeveloped countries where they are plentiful. These products wind up in the garbage piles of the industrialized countries, where the raw materials are scarce.
- Look to increasing emission standards significantly impacting future transportation decisions. There will likely be increasingly limited access to urban areas by vehicles.
- In order to make good capital investment decisions, compliance costs that include the costs of recycling, need to be included in the Internal-Rate-of- Return (IRR) calculations. One member's company already does this in making plant location decisions.
- One problem with companies joining cooperatives to handle recycling needs is that there is usually no incentive to make their products any more 'recyclable' than the regulations require.

5. Supply Chain Response to Macro Factors

5.1 Rising cost of Oil - $500/barrel

This discussion invited reactions from the council members for a scenario wherein the price of oil has shot up indefinitely and has reached an extremely high point, say $500 per barrel. Broadly speaking, the reactions focused around following key points:

- Localization of production, and moving sourcing and production closer to the point of use in order to negate the heavy cost burden of transportation.
- Higher awareness of variable (versus fixed) costs and taking decisions reflecting this readjustment by segmenting customers for revenue maximization
- Consideration of recycling as a main option for recovering costly raw material
- Realignment due to unequal impact of this burden across the globe leading to a rebalancing of capabilities and power among nations, and changes in consumer preferences and behavior
- Need for a joint response of the state, market, and societies working together to alleviate the resulting pressure by taking diverse actions such as tax concessions, recycling and reuse, and innovative technology.

5.1.a Move towards decentralized supply chains

Specifically, the following points were raised during the discussion about more localized and decentralized supply chains:

- The Electronics industry will react by moving closer to the customer and suppliers, although this not very important to the viability of their business.
- Some industries are oil-based and will be seriously hurt by a dramatic shift in oil price, such as the Glass industry that is very sensitive to the price of oil.
- Manufacturing will move closer to the customer and supply chains will transform to reflect higher local content.
- For high-value and high-volume products, the current approach is to build the products using facilities all over the world (fabrication, assembly, testing.) It was highlighted that this design is very sensitive to the transportation cost. Indeed, in this specific case, the supply network was moving a large volume of product all over the world and hence becoming more sensitive to transportation cost.
- An obvious response in this scenario will be the redesigning of the supply chain with more decentralized structure, but that will in turn entail overhead costs such as higher cost of coordination and collaboration.
- Current supply chain optimization is driven by the amount of inventory held and distribution costs. In the past years, the trend was to move from country-based distribution centers to pan-European distribution structures. But with the balance shifting in this trade-off, the structure will return back to the country-based structures which may lower international trade -- impacting the custom tariff income to countries among other consequences.
- Supply chains that are more dispersed and spread seem to be less robust due to higher likelihood of disruption. This change (requiring presence in many markets to make and deliver products locally) may impact the complexity of supply chains and the need for coordination will go up.
- It is important to note that the impact of this increase will be uneven across various transportation modes as well. In other words, the supply chain networks will address this shift by reconfiguring the structure and strategies before giving up globalization or off-shoring immediately. There will be more product volume moved using ships than air, as well as moved using rail (that is less sensitive to oil prices) versus truck. This will lead to longer lead times resulting in related issues such as lack of flexibility and speed, less reliability, and higher pipeline inventories.

5.1.b Manufacturing and Sourcing

It is important to separately consider the effect of rising cost of oil on manufacturing and transportation; i.e., effect on making versus moving the product, since the response might be accordingly different by industry. Points made by council members in this area included:

- If oil prices significantly affect the cost of manufacturing then substitution will become critical versus the effect on transportation, which will result in the reconfiguration of the supply chain to lower transportation costs.
- At very high oil costs, recycling will become more attractive for oil-based discarded products.
- A very high cost of oil will sharpen the focus on the cost structure (ratio of fixed cost versus variable cost). At the moment the Chemical industry is very high fixed cost driven, but with the cost of oil going up, the variable cost will play a bigger role in their decision making. In a high fixed cost environment, the focus is on keeping the machines busy even though the product prices have to be lowered (minimal margins) to sell large volume of product. But this will change in the new environment. Companies will move away from an Asset Utilization and Customer Response focus to become more focused on Efficiency.
- This may lead to changes in the business model. Instead of making to stock, it may make sense to make-to-order and refuse certain orders. It may make sense to do some yield management for the available material (instead of capacity as is often the case.)
- Postponement may be an option and companies may focus on redesigning the product using a smaller variety of products and allow postponement.

Someone posed the question: What will happen to JIT? Will it die? Since we do small and frequent shipments it will not be as attractive to the manufacturers in such a scenario that drives up transportation costs.

One response would be to leverage better techniques, such as cross docking, to ship more value across the network instead of doing larger and fewer runs. Other comments about JIT's future included:

- In its true form, most of the suppliers are close to the makers of the final products so that the transportation costs are not significantly large.
- It will indeed make the supply chains more regional and focus will shift from global to local, and globalization may not be used as the main strategy.
- In addition, each case of JIT will respond to this change differently since the implementation of JIT varies from place to place. In instances where using JIT requires significant transportation cost, it will certainly have a negative impact.

5.1.c Macro and Governmental Responses

Feedback from council members demonstrated that there are multiple layers of responses to this oil price scenario. It is a macro issue that will be met with macro response first before percolating down to the micro/company-level. It is also important to realize that if the oil price goes up precipitously, it has the potential to crash economies. This has significant political ramifications and will impact more than just businesses or supply chains.

Governments and international organizations will step in and make some structural adjustments to alleviate the pressure.

It appears that the impact of this increase will deal a crippling blow to developing economies in comparison to the developed economies. Developed countries are more technologically and politically advanced and may be able to absorb the shock more effectively compared to the poorer countries. (Would Germany, for example, lower its highway taxes to alleviate the oil price impact on businesses?)

The ability to respond to this scenario will differ between countries and hence create uneven impact. Such an increase will lead to a global shift of power between various players such as OPEC. It may localize the production and help some of the backward countries by transfer of capabilities to these countries. Technology will offer another means to respond to this problem in the shape of alternative forms of transportation that will become more attractive, as well as alternative fuel choices.

5.1.d Environmental Impact

High oil prices will also make companies sensitive to waste and environmental issues and allow them to make changes that will allow for more socially responsible behavior. Some companies will be reactive, while others will decide to become proactive.

The oil price increase will have an impact on the recycling of materials. It is likely that choice and management of packaging material will undergo change – possibly reversing the move from paper to plastics-based packaging that has been going on over time. Products that are highly sensitive to the cost of oil in their manufacture will become a better candidate for recycling at the same time, while products that are sensitive to oil in transporting the product may see a decline in the recycling volume.

5.1.e Consumer Behavior and Preferences

This rise in oil prices will certainly affect the opportunistic subsidized businesses, such as moving crops around for processing (e.g., potato chips from potatoes, in Europe). It will also influence the behavior and preferences of people to prevent unnecessary movement of goods.

In a way the globalization trend will be hurt by people buying local products. However, for critical items, these businesses will remain global with significant importation. A form of globalization that may take hold will result due to demand for global brands that are made locally. The markets will become very local in every respect and regions will become more self sufficient.

It will impact the fresh food supply chain, with limited imports from far flung places. Importation may still be operative for high value added items that are critical, but the luxury items may die first. (This may seem a little confusing since luxury items are typically expensive. In essence, it may lower the traded volume as a result leading up to higher prices and a vicious cycle may ensue.)

5.2 Economic environment of a few powerful trading blocks

This scenario dove into a situation wherein the world is divided into regional blocks that share common goals and issues. These might be centered around Europe, the US, Japan/Asia and China.

It is likely that in such a situation, there will be significant political and societal ramifications, and businesses will have to respond accordingly to reflect the will of the people. At the same time, it will not be easy for businesses to give up benefits of globalization easily and the challenge will be to blend different models and structures to offer products and services efficiently.

Based on the responses of the council members it appears that this scenario will not have a significant impact on the overall direction of running a business. Indeed, there will be a shift in priorities and strategies, with local and global supply chains morphing into a new hybrid structure that will leverage available opportunities. There are reasons to believe that the overall cost of doing businesses may come down due to simplification of infrastructure; while at the same time, due to issues around reliability, the cost of managing supply chains may in fact go up. Specifically, the following 'mixed-bag' of points were raised by the council members:

- This may not impact the pharmaceutical industry significantly as it currently operates this way. The lesson from their experience is that the trade will follow the incentive structure in place and businesses will exploit whatever opportunity is offered to them to capture a market and make profit.
- Move away from global focus to a more regional focus and the logistics systems will follow suit. For European companies this may just take them back to greater use of the low-cost manufacturing countries in Eastern Europe.
- As long as there are mechanisms that will facilitate trade, it should not be a problem. It is likely to create problems if trade barriers affect global trade. If there is a tendency to operate within a block it may raise barriers to global trade. In addition, custom duties, and taxes can create barriers if set high.
- It will impact the services offered for clearing products across countries and custom revenues will diminish for certain entities.
- The severity of the impact will be driven by the customs and administrative protocol between the blocks. In essence, there will be very little resistance intra-block (the very definition of trading block,) as a result, the cost of doing business inside the block will go down. Interestingly, since there will be fewer interfaces across the world (only between the blocks) it will be easier and less costly to facilitate global trade as well (instead of point-to-point interaction with a cost associated with each arc, there will be a few arcs loaded with cost, but most with lower costs).
- At the same time, this will also lead to companies going into multiple blocks to leverage the facilitated trade within the block and hence encouraging distribution of capabilities.

- On the other hand, as a result of the formation of the blocks, it is possible that barriers may develop between the blocks affecting the reliability of supplies across the blocks, with a negative impact on the performance of the supply chains. A single, short-term event due to these barriers that can adversely impact the supply chain will make companies more sensitive to similar problems in the future. Although it may not lead to immediate structural changes, it will make the environment less predictable and create problems for the supply chains. One result will be the need to build in flexibility.
- There could be problems due to lack of coordination and cooperation between the blocks leading to the lack of reliability of supply chains. Supply chains will become fragile and require more inventories to support them, and their performance in terms of cost/speed may suffer.
- The need for reliability and performance will lead to structural changes in the long run within the block in terms of markets, brands, suppliers, and manufacturers. Such a behavior will lead to segmentation of the supply chain based on capabilities required to support a variety of end products and may require development of redundancy in the system.
- The creation of blocks will result in a war between global and regional brands, and accordingly impact the supply chains.
- The trend of contract manufacturing may be adversely affected by this development.

5.3 Companies falling into traditional and proprietary mode, drastically reducing collaboration:

This scenario considered the case where the companies will shy away from extensive collaboration, considered a foregone conclusion by most futurists. It is likely that companies may stop sharing information and collaborating under the threat of IP theft and treat information as a competitive advantage -- indicating a lack of trust among partners in different regions or in the same region.

Interestingly, this issue resonates with certain industries even today as they face the threat of counterfeits in a big way -- especially in technology-related areas and with regard to China. From council members' responses, it was not easy to discern if this trend will deal a debilitating blow to trade in general. The general sense was that businesses will take the matter of IP risk in its stride and work around it to find effective solutions to do business. Even if they decided not to share information and IP, there will be other mechanisms by which businesses will continue to operate. Specifically, the following points were discussed by the council members:

- This is a big issue for electronics manufacturers who are trying to find ways to remain competitive by developing new products but keep costs low.

- Companies are affected by this issue even now and that does impact their capacity allocation decisions for making new products.
- In many cases, however, the collaboration among companies creates value mainly by moving product effectively to the end customer without having to share IP or critical information – such collaboration is driven primarily by monetary objectives.
- Encryption technology will become more prevalent to protect IP; i.e., companies will focus on design for manufacturing and supply chain to continue to leverage their existing infrastructure by using sophisticated methods to address this threat.
- In many high tech industries there is higher convergence of hardware and software allowing for a simpler solution to the problem around IP risk. High tech companies may have to become truly global to compete in this type of environment.
- The other threat that was brought up was of increasing capabilities of outsourcing countries that will produce equally competitive products. But this is a different issue that highlights the problem of additional players and increased competition.
- Some big companies may not worry about IP as much since they will focus on branding and marketing their products, and have someone else manufacture the product.

Does IP mean what to make and how to make? In the case of pharmaceutical, the bigger concern is the science and development of products rather than making them. In the case of the telecommunications world, both matter and have to be protected using means such as encryption.