

Proceedings of the Supply Chain 2020 Project's
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Table of Contents

1. BACKGROUND.....	1
2.0 GLOBALIZATION SCENARIOS DISCUSSION	2
2.1. OVERVIEW OF ISSUES	2
2.2. THE PURSUIT OF CHEAP MANUFACTURING LABOR VARIES BY PRODUCT	2
2.2.1 <i>Regional Manufacturing for Liquid-Based Products.....</i>	<i>2</i>
2.2.2 <i>Asian Manufacturing for High Tech and Complex Manufactured Products.....</i>	<i>3</i>
2.2.3 <i>Parts of Chemical and Pharmaceutical Manufacturing Might Move Too.....</i>	<i>4</i>
2.2.4 <i>Retail and Transportation follow Manufacturing and Consumption.....</i>	<i>5</i>
2.3 INNOVATION AND INTELLECTUAL PROPERTY ARE BIG CONCERNS	5
3. THE METRO GROUP'S RFID INNOVATION INITIATIVES.....	7
3.1. INITIATIVES INCLUDE THE FUTURE STORE AND THE INNOVATION CENTER.....	7
3.2. THE FUTURE STORE LOOKS TO ENHANCE THE GROCERY SHOPPING EXPERIENCE.....	7
3.3. RFID INNOVATION CENTER LOOKS TO IMPROVE BACKROOM OPERATIONS AND THE DEPARTMENT STORE	8
4. RFID DISCUSSIONS.....	9
4.1. EUROPE MIGHT WELL BE THE LOCUS OF RFID APPLICATION INNOVATION	9
4.1.1 <i>EU companies have deeper process knowledge than in the U.S.....</i>	<i>9</i>
4.1.2 <i>EU firms have a higher need to collaborate.....</i>	<i>10</i>
4.1.3 <i>High need for collaboration with their suppliers.....</i>	<i>10</i>
4.1.4 <i>Europeans focus more on identifying the business case</i>	<i>10</i>
4.2 THE METRO VERSUS WAL-MART APPROACH IS A CASE IN POINT	10
4.3. THE DISRUPTIVE PROCESSES HAVE YET TO BE IDENTIFIED	11
5. WRAP-UP	12

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 further 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 two phases. The objective of Phase I is to understand excellent supply chains and the underlying strategies, practices, and macro forces that drive them. Leveraging what is learned during the first phase, Phase II of the research will project 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 excellence. 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 Spring 2005 (and 2nd semi-annual) meeting of the EAC was held on March 22, 2005 at the METRO Group RFID Innovation Center in Neuss, Germany, to solicit insights from the corporate supply chain executives. Faculty from the Zaragoza Logistics Center were also in attendance to provide additional insights. The meeting was moderated by Larry Lapide and Jim Rice of MIT, and was supplemented with METRO staff tours of the Innovation Center and the METRO Group's Future Store. The meeting had the following agenda:

1. Optional tour of METRO Group Future Store
2. SC2020 update (Larry Lapide of MIT)
3. SC2020 global footprint discussion (moderated by Larry Lapide)
4. Tour of the RFID Innovation Center
5. RFID in the future discussion - (moderated by Jim Rice of MIT)

2.0 Globalization Scenarios Discussion

At previous Industry Advisory Council (IAC) meetings, the largely U.S.- based group considered a series of globalization scenarios and issues. To get the European perspective on these issues, the EAC members were divided into breakout groups to discuss their views on how industry global supply chains might evolve. Following this, Larry Lapide moderated a discussion of each breakout group's views. The shared views will feed into Phase II of the SC2020 Project.

2.1. Overview of Issues

The breakout discussions of global scenarios and issues centered around three core questions:

- What will the global supply chain footprint look like for manufacturing in different industry domains (e.g., PCs versus Autos versus Apparel)?
- Which resources might have excess supply versus demand (e.g., labor, energy, steel etc.)?
- Will regulatory regimes (e.g., labor, environment, trade) be globally uniform or highly varied?

In dealing with these questions participants were asked to consider: Where would the major centers of sourcing & manufacturing, product consumption, and innovation be in the future (by industry)?

2.2. The Pursuit of Cheap Manufacturing Labor Varies by Product

Much of the discussion focused on where manufacturing would be located in 2020. The general consensus for the industries considered was that it would continue to move to low-wage countries, when it made sense. Which countries it would move to would be highly dependent upon the product and the industry.

2.2.1 Regional Manufacturing for Liquid-Based Products

Liquid bulk products with high-water content would most likely be regionally manufactured to be close to the point of consumption for a variety of reasons. These are often consumer products such as Personal Care and Food & Beverage. The manufacturing of these water-based products is not complex and the products need to be made to satisfy local preferences. The expense of transporting water-based finished products would be too high to justify moving to low-cost off-shore manufacturing. Countries in Eastern Europe, such as Poland, The Ukraine, and Russia, would likely see a rise in manufacturing to feed the more developed Western European countries -- much as Mexico and Latin America might feed the U.S. and Canada.

An exception to regional manufacturing of these products would be special products that are made from concentrates by adding water closer to the point of consumption. These might be manufactured in one or two plants globally, and shipped around the world (e.g., much like Coca Cola and Unilever's Iced Tea product).

Other exceptions would be products with raw materials in short supply and where the raw materials are perishable. There may be only a few main processing operations that are located in close proximity to the raw material source. One example of this is fresh fish that has limited supply in Europe. Food products that include this highly perishable component frequently have to be pre-processed outside Europe, closer to where the fish is caught.

One EAC member jokingly mentioned that the regional manufacturing of these types of products would change only if the cost of oil went down drastically -- but all EAC members thought the chances of this happening were nil, more likely to go up drastically.

2.2.2 Asian Manufacturing for High Tech and Complex Manufactured Products

High-tech and complex manufactured products on the other hand, would be a different story in 2020 -- more likely to be globally rather than regionally based. Manufacturing for these products would most likely continue to move to low-cost countries, to be shipped to global end destinations. Most of the EAC discussions about these products focused on offshoring, with Asia -- especially China and to some extent India -- as the place where manufacturing would be located for these types of products. Typically the cost of transportation is insignificant relative to the price of the products, even if air freight is used to reduce lead times for short product lifecycle or fashion products. These types of products are typically produced by the highly technical, electronics-based industries such as Semiconductor, Consumer Electronics, and Small Appliances.

The general consensus was that for these industries Asia would be the global manufacturing hub based on the following points:

- Asia is expected to be a source of low-cost labor over the foreseeable future. While China may develop along its coastal areas into high-wage areas, there are sufficiently large populations in the interior that could be tapped as a labor pool.
- Semiconductor manufacturers have largely relegated most of their manufacturing to Asia already and see no change in this moving forward. Perhaps it may move within Asia from China and Malaysia to India.
- Smaller consumer appliances are already manufactured in Asia in great measure and will likely continue into the future. On the other hand, larger appliances including white goods have not and may not move to Asia, with the exception being for products destined for Asian consumption. These products are larger so the cost of transportation is comparatively high when shipping long distances. In addition, their manufacturing is not labor-intensive so the pressure to move to low-cost manufacturing areas is not strong. Lastly, since these large products need to be designed to local tastes and requirements, manufacturing will likely stay close to the points of consumption. This also means that manufacturing of these products in China and Asia would mostly be done to support the demand

for these products in those regions, not for export purposes, as is the case for small appliance manufacturing.

- Since China is rapidly growing economically the region is expected to be a major point of product consumption. Additionally, the region will likely be a heavy purchaser of industrial products that are needed to develop China's infrastructure in support of its growing consumer businesses. This makes it even more attractive to manufacturers from developed countries, in both Europe and North America.

Some participants warned that China might become self-sufficient in the long-run, and hence less interested in two-way global trade. China might be both a major producer and a major consumer of high-tech and complex products, for example. Under this scenario China might have its own product regulations tailored solely to its market. This would leave non-Chinese multinational companies (MNCs) with little to offer in the Chinese market. This scenario should not be discounted. Many firms are at risk of not enjoying market access, despite having invested over many years to help develop infrastructure that today is in sore need of improvement for China to adequately support its burgeoning businesses.

A couple of scenarios were raised if the unabated flow of manufacturing to China continues unchecked. In one scenario, the governments of developed countries might react with trade regulations restricting trade with China in order to hold on to their manufacturing jobs. One Council member aptly pointed out that this government intervention might not work since China may not be concerned, since it may be virtually self-sufficient. A second scenario was that the current material shortages (such as in steel, cement, and oil) might continue in the long-run, hampering China and Asia's infrastructure development -- thus dampening the flow of manufacturing jobs into the region.

2.2.3 Parts of Chemical and Pharmaceutical Manufacturing Might Move Too

Included in these highly technical and complex manufacturing industries are Chemicals and Pharmaceuticals, which are also expected to move significant portions of their manufacturing to low-cost areas, despite a relatively high cost of transportation for these products.

For example, today Europe has the capacity to produce 30 million tons of polymers and feedstock. However, a significant portion of this manufacturing is likely to move to the Middle East, closer to the oil-well head. Indeed, the Middle East is planning to build 20 million tons of capacity over the next 10 years. In addition, as Asia increases its consumption of these types of products, the Middle East becomes even a better place to produce these goods from a location basis. So Europe will likely be a loser in the long run for these types of products.

Specialized finished products, such as film polyethylene, that can be shipped more densely, are also candidates for moving manufacturing to the Middle East because transportation costs are a small fraction of revenues. In contrast, manufacturing for industries such as final product molding will likely stay in Europe as the cost of transportation is high, since moving these products entails 'shipping mostly air'.

Where manufacturing will be located for the Pharmaceutical industry is a mixed bag. Because of strict regulations and requirements for tracking and tracing products all along its supply chains, pharmaceutical companies tend to keep the supply chain as short as possible by keeping manufacturing close to consumption. This helps minimize counterfeits and reduces 'proof-of-pay' issues. However, mass-marketed drug manufacturing and the first steps of chemical synthesis will likely move to Asia to reduce labor costs -- such as to China and India. Finishing process steps and the production of specialized drugs will likely stay close to local markets, because these processes require 'knowing your patient', meeting local regulations, and keeping shipping costs low.

2.2.4 Retail and Transportation follow Manufacturing and Consumption

The Retail industry will always be local since it has to cater to local demands. That said, where it sources product from will continue to be shaped by where goods are manufactured at the lowest costs in the context of transportation costs. As such Retail will source product locally only if local suppliers are needed to cater to local tastes. Generally, the industry will source products from anywhere around the world for products that are suited for global consumption. This includes potentially going around a branded company by sourcing private-labeled products directly from the company's contract manufacturer, if lower costs can be achieved.

Many food and beverage consumer products will continue to be sourced from local suppliers because the products need to satisfy local tastes, and are often perishable -- and these can't use transportation modes that take long periods of time. For general merchandise, the sourcing decisions will be based largely on what supplier has the lowest landed cost to the retailer.

The Transportation industry will mainly follow supply chains as they evolve. Third Party Logistics providers (3PLs) generally believe that their role is being able to provide services to support both local and global supply chains, regardless of whether manufacturing is mostly outsourced or not for different products. In fact, these 3PLs see it as a business opportunity to help manufacturers seamlessly ship goods to and from anywhere in the world. Manufacturers will always need to balance product versus transportation costs, and 3PLs are planning to be the best place for manufacturers to go to get help with this. Under the current trend of both rising labor and oil costs, this balancing become even more critical, creating more of a need for extended 3PL services.

2.3 Innovation and Intellectual Property are Big Concerns

Where will product innovation take place? This question was posed to Council members throughout the discussions. The question is important because historically, developed countries have relied on developing new products, doing the early production of them, and then frequently off-shoring their manufacturing to reduce costs to support mass market global consumption.

This trend constantly puts pressure on the developed countries to drive their economic growth largely through new product innovation and development. Exacerbating this will be

the fact that the developing Asian countries, such as China and India, are training greater numbers of engineers and scientists than the developed countries, such as the U.S. and the Western European countries. This will make these Asian developing countries capable of doing much of their own product innovation by the year 2020.

As Council members discussed where manufacturing might move, many were concerned that too much might move to Asia, as the trend has been to gradually move greater innovation there along with it. Several issues were raised:

- In highly technical industries such as Computers, Electronics, Semi-Conductors, and Pharmaceuticals, Intellectual Property (IP) and copyright issues have long been problems in China. Forming Joint Ventures (JVs) with companies in China and Asia is generally risky because these countries don't have Western-style legal infrastructures in place to protect IP and enforce patents.
- Because of these concerns companies have to balance moving manufacturing offshore for lower costs and keeping their IP in the long run. For example, it costs several billion dollars to build a Semiconductor fab. With these high costs-of-capital, plants have to run for some time to justify building new ones overseas. This coupled with the risk of losing future revenues to an overseas partner that you trained, makes the building of these fabs that much riskier.
- It was noted out that many of the Chinese apparel plants that currently are being built are highly-automated. This will help China keep the apparel business over time rather than it moving to the next low-cost country in the future. In addition once Chinese managers become knowledgeable in the workings and IP of an industry like this, it will not be so easy to move them to another country on the basis of labor costs alone.
- A more optimistic view was shared that developed countries might be able to keep a lock on technology (vis a vis product) innovation over the long run because of culture. Asian countries have historically been good at product innovation, but not necessarily technology innovation. Would this be true in 2020?
- Pharmaceutical companies today worry a lot about maintaining IP. Often they survive solely on their patented drugs. The European industry maintains a network of research partnerships around the world including in Singapore, India and Malaysia, as well as in North America. They do this to be close to the companies that start up around the major universities, especially for labor-intensive pure product research. Yet the industry needs to constantly make sure that once products are in the development stage, that the firm has ownership so they can fully exploit the IP and patents.

3. The METRO Group's RFID Innovation Initiatives

3.1. Initiatives Include the Future Store and the Innovation Center

The METRO Group's initiatives in RFID are collaborative and broad in that they are experimenting with future technologies to be leveraged to support both the demand-side and supply-side of retailing. The METRO Group and its sales & service companies have partnered with around 50 of its suppliers and technology providers under these initiatives. These partners include:

- System infrastructure providers such as IBM, SAP and Intel
- RFID hardware and services solution providers such as Cisco, DHL, and HP
- Brand manufacturers such as Johnson & Johnson and Procter & Gamble

Partners co-sponsor the research in order to collaboratively gather information about RFID deployments, and to test technology solutions under real-world, as well as simulated environments.

The Future Store initiative involves one of The METRO Group's working supermarkets (in the vicinity of its headquarters) where sponsors can see the technologies in action and test their own RFID solutions, in a real-world environment. Partners can use the RFID Innovation Center's simulated environment -- housed in a working distribution center in Neuss, also in the vicinity of METRO's headquarters. -- in very much the same way. The Innovation Center has mock-up environments of warehouse backroom operations and the front of a soft-goods department store. (More information about these initiatives can be gleaned from The Metro Group's extensive website on the subject at: www.future-store.org/servlet/PB/-s/whmedt2o8s8z19bqxswb7uasagcglon/menu/1003319_12)

3.2. The Future Store Looks to Enhance the Grocery Shopping Experience

The majority of the technologies being tested in the Future Store are in the front of the grocery supermarket where every-day shoppers can try out applications geared to enhancing their shopping experiences. This includes technologies that can help retailers keep their shelves stocked and make shopping faster, easier, and more individual. Some of the innovative applications being tested in the Future Store include:

- The *Smart Shelf* involves RFID readers that detect the time and number of goods taken off the shelf. This establishes an electronic real-time perpetual inventory information system that can help a retailer keep goods on the shelf, helping to reduce stockouts.
- *Intelligent Scales* have cameras in them that attempt to automatically identify the produce that a customer is weighing, in order to print an appropriate label for it.

- The *Everywhere Display* is an information system that allows a shopper to interactively access information about a product (that has a smart chip on it) that they have just taken off a shelf
- The *Information Terminal "Meat Supply Chain"* uses smart chips to automatically recognize meat picked up by a shopper and then display information about the specific product's supply chain history - from breeding to shelf.
- The *Electronic Pricing Labels* are price displays on shelves that have a wireless connection, permitting instantaneous price changes without physically re-labeling products or shelves.

In addition to the above, there are other point-of-sale information displays that change depending on shopper experiences. These include electronic advertising displays that change instantaneously as items are picked up, as well as an innovative wine selection display that not only helps a shopper select an appropriate wine, but also helps the shopper locate it, by shining a light on the floor near the wine's shelf location.

3.3. RFID Innovation Center Looks to Improve Backroom Operations and the Department Store

The Innovation Center presents a series of technologies in simulated or mock-up operating environments. In comparison to the Future Store where technology testing is limited to what makes sense in a working store, the Innovation Center is able to host a wider variety of front-store and back room advanced technologies. Some of these include:

- *Picking Systems* that help streamline the flow of goods in backroom operations. These include a Pick-by-Light system that shines a light on the location of RFID-tagged goods to be picked, as well as a Hanger Sorter system that guides hanged soft goods that have identification tags on them. Also included among these are systems for the improved tracking, picking, and sorting of tagged stackable goods, cartons, and pallets.
- *Warehouse Management* systems that improve the visibility of goods within a warehouse. These include permanent fixture reader systems in different parts of the warehouse (such as on the lift truck and on the storage racks) that register items as they are moved into and out of a warehouse. These readers are also located on the hanger goods conveyor systems for identifying items coming into a warehouse. For goods management within a warehouse, the Innovation Center demonstrates handheld RFID readers for inspection and cycle counting.
- *RFID in the Department Store* systems that are aimed at individualizing the shopper's experience. One such system includes an intelligent changing room that houses an RFID reader to identify an item and provide the shopper with more information about it. Another system provides additional information on goods being removed by a shopper.

In addition to these innovative systems for the store or backroom operations, the Center also demonstrates a *Smart Fridge* and *Intelligent Freezer* for home use. The systems monitor and report on the goods inside them, including their date of expiration, and a recommended shopping list.

4. RFID Discussions

Following a tour of the METRO Group's RFID Innovation Center, EAC members discussed the future impact of RFID technologies. The initial RFID discussions focused on several questions:

- “Is RFID an innovative, disruptive technology?”
- “What is the European perspective about RFID as a disruptive technology?”
- “Is Europe the global locus of RFID application innovation?”

Throughout the discussion, ideas for specific processes that might render RFID technology disruptive were solicited from the EAC members.

4.1. Europe might well be the locus of RFID application innovation

The premise of the last question above was posed in response to a comment made by one of the members participating on the IAC webcast the prior week. He suggested that the locus of innovation for making RFID a disruptive technology was in Europe, not the U.S. -- especially around The METRO Group's various European-based initiatives. The group discussed this, and by and large, asserted that they believe Europe to be the locus of innovation for RFID applications.

The group provided a number of reasons to explain why they felt the European Union (EU) was more innovative in RFID applications.

4.1.1 EU companies have deeper process knowledge than in the U.S.

Because firms in EU countries traditionally serve customer bases that span numbers of countries, their supply chains involve larger numbers of parties, and effectively have more complex processes than their U.S. counterparts. These firms therefore have more experience in coordinating flows into ‘international’ customers which requires this deeper process knowledge. In comparison to many firms in the US, until recently a majority of their sales may have come from domestic customer locations, and hence did not require the intimate level of process knowledge and coordination.

In addition, as there are more distinct markets to serve in the EU, firms must develop segmented logistics and marketing practices that require deeper process knowledge, as well as deeper levels of coordination. Ultimately these place high demands on the management of European supply chains.

4.1.2 EU firms have a higher need to collaborate

Supply chains in the EU are more complex because there are more parties involved with flows that cut across more country and company lines. Because the supply chains throughout the EU are more complex, there are more interdependencies that need to be considered and coordinated in order to run a successful supply chain. Firms need to be able to articulate their key processes more accurately and distinctly so that the processes can be integrated across these many different parties, countries, and companies.

4.1.3 High need for collaboration with their suppliers

Although it may be a gross generalization that does not accurately reflect all firms, there may be a predominant organizational 'culture' for EU firms that entails an orientation towards collaborative relationships with suppliers. One EAC member commented that BMW, Porsche, and Daimler-Chrysler have a 'different attitude' in working with suppliers than the traditionally adversarial approach of some US automotive OEMS such as General Motors.

4.1.4 Europeans focus more on identifying the business case

It appeared to the EAC members that the focus in the U.S. seems to be more on the use of the RFID technology alone. In Europe they believe they are looking more at the process, people, and tool aspects of RFID, in contrast to initiatives in the U.S.; especially Wal-Mart's focus on mainly the tool. Someone pointed out that ERP implementations in Europe were analogous to the current RFID initiatives. They were more complicated in Europe because of complex supply chains, and this meant one had to also place greater focus on all three aspects of process, people, and tools.

Generally the business case for new technology is important to Europeans, more so than in the U.S. For example, one European company is already buying equipment and considering RFID in their warehouse designs. The company is confident that benefits will accrue from RFID, but only reached this conclusion after a lot of due diligence was done -- in contrast to what appears (to EAC members) to be the leap-of-faith approach of Wal-Mart's mandate.

One EAC member noted that METRO is actually experimenting with RFID in a working store, showing more of a commitment towards establishing a realistic business case, than their U.S. retail counterparts.

4.2 The METRO versus Wal-Mart Approach Is a Case in Point

The group drew a stark contrast between two major RFID adoption initiatives, comparing Wal-Mart's mandate approach to The METRO Group's initiative, and at times, as well to Tesco's. The group suggested that being forced to adopt RFID limited its potential -- by virtue of the way that METRO asked its suppliers to participate, rather than being mandated to comply. Together the suppliers and METRO can develop a better implementation. Paraphrasing some comments made:

- One member said "that it's always better, even though it will take a little more time, that you ask, because only if you ask, will you get some answers that are important in putting the issue forward. Otherwise you will just do it because somebody tells you, and we all know this is the path that is not necessarily guaranteed to get better results".
- Another MNC member said that "Wal-Mart told us to, whereas METRO asked us to it. So for Wal-Mart, we do slap-and-ship, and just do what we're told to do; with METRO and Tesco, we are actually trying to understand the implications of RFID so we're doing more than slap-and-ship, we're actually trying to understand 'Does it work? How does it not work?'"

The group agreed that by asking the supplier a more open question "How can we apply RFID to our collective supply chain?" the customer enjoys more insights and innovation in the application benefits that provide advantage for all parties.

Some of the differences in the two RFID adoption initiatives can be attributed to the different purposes that each RFID adoption serves within each business. At Wal-Mart, their focus is on logistics optimization and that fits with their strategy to offer every-day low price, being a low-cost competitor. At METRO, their approach is different and more oriented at using the technology to enrich the consumer experience, as well as enjoying some of the potential logistics and supply chain efficiencies.

The implications of these points are significant. By using a mandate, firms are directing the suppliers to focus their efforts on slap-and-ship implementation – this effectively forces the suppliers to apply scarce development resources towards near-term solutions to satisfy mandates rather than exploring the potential of the technology. One can then argue that those firms able to tailor the technology to their application (e.g. those firms working with METRO and Tesco) may actually be further ahead in terms of leveraging the technology, identifying productive applications, creating effective long-term solutions, and building more robust applications and business cases. Therefore the mandates may actually be retarding the application of the technology, squandering valuable resources on activities that are not producing commensurate value-add instead of identifying and exploiting potential disruptive applications of the technology.

4.3. The Disruptive Processes Have Yet to be Identified

A variety of ideas for what would be the processes that would truly make RFID a disruptive technology -- allowing new companies to topple market leaders, or existing companies to wipe out their competition -- were discussed.

It was generally agreed that RFID could potentially touch on all processes involved in the physical flow of products, helping to identify items as they move along the supply chain. Inventory would be easier to manage if one knows its location. Other ideas included better warranty and returns management of high-tech equipment, and improved tracking and tracing of pharmaceutical drugs. It might cut down on computer fraud.

In Pharmaceutical, however, it was felt that the biggest impact would come when customer demand and prescription information could be collected via RFID, rather than manually as is done today.

While all these process ideas sounded good, one EAC member countered that most could really be done without RFID using some of the other identification technology already in use today -- for example, barcodes. Others shared a different perspective, seeing a fundamental difference between the barcodes that need line-of-sight for identification and the RFID tags that don't need it to be read.

In summary, while a variety of process ideas were generated, the group struggled with coming up with any 'killer application' that was going to make RFID truly a disruptive technology.

5. Wrap-up

The next EAC meeting for the project will take place some time in September in Europe. This meeting will feature presentations of the SC2020 work performed during the first phase of the project, as well as discussions on the research plans for the second year of the SC2020 Project.