E-book

The uncharted frontier in optimizing freight costs

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Foreword

What's next in supply chain cost optimization?

The high degree of choice and personalization that customers have today has repercussions for all aspects of the supply chain. Traditional models of planning, sourcing, manufacturing, delivering, and returning products – the basic stages of the SCOR model – are being upended. The pressure for companies to quickly reduce their total cost of goods (TCOG) to maintain their margins and competitiveness is tremendous.

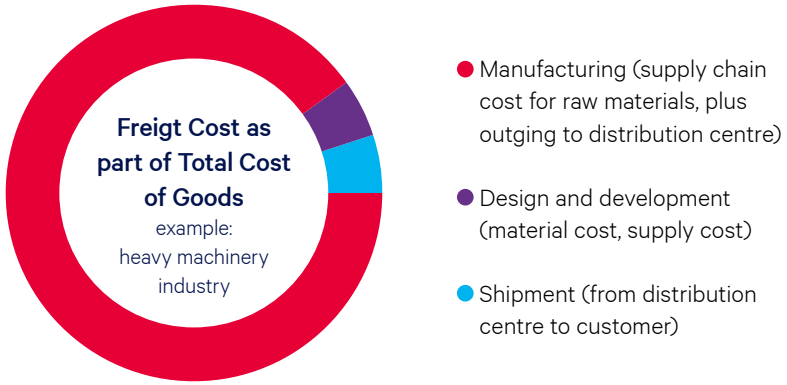
Over several decades, a considerable amount of effort has been directed at achieving optimizations on the downstream part of supply chain. The focus has been on getting finished goods from the factory floor to the retail door as cheaply as possible, while still meeting delivery timelines. As a result, just about every conceivable savings in downstream logistics has been discovered and exploited.

The new frontier for supply chain optimization

The uncharted waters in supply chain optimization are upstream. Freight cost reductions in the sourcing of raw materials and component parts can have a direct impact on the delivered cost of the finished goods.

However, despite the strong contribution of freight to upstream supply chain costs, a considerable number of organizations demonstrate an alarming lack of understanding of how they accrue. Even among those who have an appreciation for it, they are sidetracked by a plethora of factors – quarterly objectives, short-term challenges, mergers and acquisitions, crisis management, etc. Add to this – lack of resources, lack of ownership or KPIs in this area and a general lack of visibility over how costs accumulate - the list goes on. In balance sheets, "freight costs" are just lumped into one category with very little granularity on their composition. **The aim of this e-book is to explore all of the various components of the TCOG.**

Once companies have an understanding of the ways in which freight costs accrue, they will realize that the long-held 'wisdom' in "outsource manufacturing to a cheap labor country" will need to be questioned. For example, re-shoring manufacturing to be nearer to raw materials, components, and skilled labor can reduce freight costs. Free Trade Agreements (FTAs) are making it more competitive to source from newer markets.



What to expect

The world of freight, logistics, and shipping today stands on the brink of a giant leap forward in terms of smart pricing, load handling, track and trace, and energy efficiency/sustainability. As the seemingly relentless cycle of company consolidation and downward price pressure shows no immediate signs of ending, we can expect increasingly greater attention to this area.

The potential for companies to look to reduce their costs through digital transformation also looms large. Already in their early roll-out stages, automation and big data are beginning to provide companies with visibility into the supply chain factors that impact their freight costs. In the near future, companies will rely on data-driven supply chains to optimize and manage their freight costs.

Chapter 1

An overview of optimizing total costs of goods (TCOG) on the upstream side, with specific focus on three areas – product design, location (manufacturing facilities, sourcing) and freight costs. We present strategies and tactics for cost-reductions, along with how freight costs need to be factored into decisions on product design and location. We also discuss how greater visibility is critical to achieving cost optimizations.

Chapter 2

A look at the various considerations pertinent to choosing locations for sourcing and manufacturing. What are the principles behind strategic sourcing? Are there situations where near sourcing isn't the answer? How do Free Trade Agreements (FTAs) impact sourcing decisions, doing due diligence on suppliers (and their suppliers), and in following the rules of origin, among others? We also present a structured approach on how companies should undertake strategic sourcing.

Chapter 3

The Internet of Things (IoT) and 3D printing – two key technologies impacting supply chains and freight cost management. We evaluate the importance of creating data visibility at the product design level and the opportunity it creates to reduce freight costs. In addition, we explore the need for visibility through IoT at the procurement stage – a further avenue for companies to manage supply chain and freight costs.

Chapter 4

How organizational cultures need to evolve to take advantage of digitalization and supply chain visibility. We present case studies and best practices on some companies that are at the leading edge in this respect and also recommend a systematic, data-driven approach to analyzing freight costs.

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The uncharted frontier in optimizing cost of goods

An overview of optimizing total costs of goods (TCOG) on the upstream side, with specific focus on three areas – product design, location (manufacturing facilities, sourcing) and freight costs. We present strategies and tactics for cost-reductions, along with how freight costs need to be factored into decisions on product design and location. We also discuss how greater visibility is critical to achieving cost optimizations.

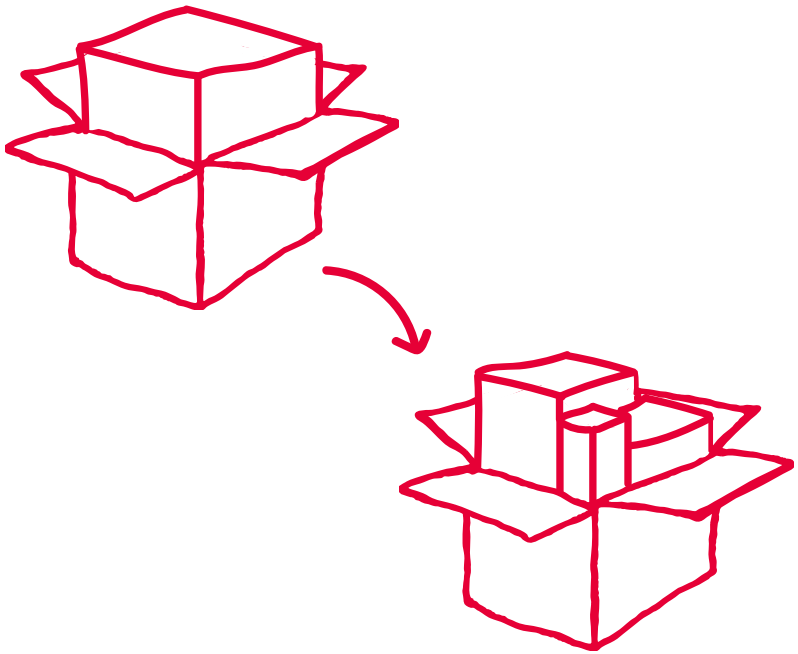
The supply chain operations reference model (SCOR), developed by the Supply Chain Council more than two decades ago remains a seminal tool for supply chain management decisions. Analyzing a company's supply chain in terms of the key steps of the SCOR model – Plan, Source, Make, Deliver and Return – can provide a deep and holistic understanding of the supply chain, based on which, companies can look at ways to optimize the total costs of goods (TCOG) and processes. Importantly, the model recognizes how decisions made at each step have repercussions down the line.

However, to date, the way the supply chain industry has gone about the task of optimizing their TCOG seems like an injustice to the SCOR model – they have largely focused on the downstream side of the supply chain, ignoring the potential for efficiencies in the plan, source, and make stages of the process. Over the last two decades since SCOR was developed, considerable research and innovation have gone into this area. However, we seem to have reached a limit on achieving further incremental results. By contrast, there has been limited research and innovation directed at the upstream side of the equation.

In this chapter, we explore this largely uncharted area – strategies and opportunities to optimizing operations and costs on the upstream part of the supply chain process. We will focus on three key areas – product design, location (manufacturing facilities, sourcing), and freight costs. We will present a case on how, by realizing efficiencies in product design and location, freight costs can be significantly optimized. We also discuss the importance of visibility – how by consolidating data across the upstream supply chain process – supply chain managers can make decisions to reduce costs.

1.1 Why Product Design Matters

Often, freight costs have been an afterthought in the product design effort. Where companies ship hundreds of thousands of components yearly, or whose products are huge, even centimeter differences can have a sizable impact on the TCOG, by enabling more of a product or its components to fit into a container. Construction and mining equipment manufacturer Caterpillar's experience is illustrative in this – by reducing the dimension of its machines by a few centimeters, the company reduced its freight costs for some of its products by as much as 90 percent (while previously only a single machine could fit into a container, with the modification, the container was able to accommodate two machines).



Unlike in companies such as Caterpillar, where the notion of an "engineered supply chain" has effectively taken root and is cultivated, in many others, the role that supply chain management plays in product design has been limited. Products are not always designed with supply chain expenses in mind. Typically, marketers tend to lead the product design effort. However, as profit margins come under pressure, companies will be increasingly compelled to review their TCOG, and incorporate supply chain management in the product design phase. While there are some companies who are already doing this, many are not taking advantage of this potential for huge cost savings.

CASE STUDY

Cross-funktional involvement in product introduction stage at caterpillar

Caterpillar used to be solely focused on "what the customer wants" in its product design. While that is still the driver for new product introductions, Caterpillar has arrived at a more enlightened view to conceptualizing and rolling out products – one that includes the various functions earlier in the process, in a way that does justice to the SCOR model. The input of various functions – finance, production, supply chain, procurement and trade compliance (taxation and customs matters) – are sought, providing Caterpillar with a broader and thus more accurate sense of the TCOG. This helps Caterpillar to make strategically important decisions on materials and production sourcing, in the context of a range of other factors such as customs and free trade agreements. The potential for software as a collaborative tool is also recognized, and leveraged.

Component sourcing

Geography has always played a big role in decisions relating to where to source for parts and raw materials. Efficiencies can be derived by limiting the number of countries you source your parts from, in the context of which countries offer favorable Free Trade Agreements. Maintaining standardized parts across a product portfolio simplifies processes and helps companies take advantage of economies of scale in various ways:

1. Forecasting for, and maintaining inventories of, lesser parts at an aggregated level, are much easier than managing a greater number of parts. The likelihood of parts running out is also lesser.

2. Lesser components create less administrative costs involved in monitoring, liaising with suppliers, coordinating, and handling shipments, as well as liaising with lesser suppliers.

3. Through standardized parts, companies can achieve considerable supply chain agility – the ability to respond to demand and supply volatility in a more nimbler fashion.

Ordering in bulk enables reduction of the total supply chain costs. This might not result in an overall lower cost though, because warehousing costs, cost per kg, inventory turns, etc. are not all included in the price negotiation.

Compact, flat pack designs

The mobile phone industry is a useful study in supply chain efficiency. Mobile phone packaging is custom-made for the high volume, commoditized nature of the business. Products that are designed to be relatively compact and regularly shaped, with flatter surfaces, are far easier to stack, more space optimizing, and thus most cost-effective to transport.

Weight is another factor that influences freight costs. However, while lighter materials do mean lower freight charges, and may also be more desirable to customers, they may be more expensive as well. A cost-benefit analysis that evaluates the net impact on total costs, as well as on product appeal (heavier products may in some cases be seen as more ‘robust’) may help manufacturers make an informed judgement on this.

Globally, companies lose billions of dollars every year due to damages to shipments. According to one study , as much as 20% of products ordered through e-commerce are returned due to damage incurred during shipments. Companies will have to factor in the costs incurred, either in the form of return shipments, shipments to replace products or to compensate for forecasted damages by shipping extra. Pre-shipment testing, to ensure that the product can withstand the hazards of shipments, such as poor handling, temperature changes, vibration, humidity or even being dropped can be a prudent way to ensure that the packaging is reliable. Packaging should be designed to suit the fragility of products, providing more cushioning where necessary. There is also ongoing research into new materials i.e. polymers that are more effective in absorbing shock than conventional materials such as bubble wraps or styrofoamplastic foam.

Reusable packaging

One significant component of shipping costs is the materials used to pack the product and then to ship them. These items, such as bulk containers, shipping racks, dunnage, pallets, and others, must be relatively durable, to permit reuse. If customers discard the package or the material used to pack and ship products, the company will need to repurchase them again for subsequent shipments, further adding to the TCOG. Reusable packages reduce the amount of material that will need to be sent off to landfills, which is another source of cost reductions. Companies need to bear in mind the cost advantages they can gain by utilizing biodegradable packaging material. In some countries legislation forces the collection of used packaging material which is another cost outlay. The set-up of the logistics process of reusable packaging is quite complex though. Often there are very few return shipments, which means the truck load on the return transportation leg can be almost empty if it only contains a few product returns and the reusable packaging. Additionally, if these operations spread across multiple countries, this will add another level of difficulty.

1.2 Location, location, location

The location of a manufacturing facility is a highly strategic decision, which will have a significant bearing on costs. When considering this, companies need to consider more than just the initial fixed costs. Costs will accrue over potentially a very long period of time, and the company must make a careful assessment of the long-term viability of the location, rather than relocating after a short period, incurring substantial costs. Due consideration needs to be given to factors such as demand volatility, decreasing lead times, delivering omni-channel services, availability of labor and shorter product lifecycles, among other things.

An organization's ability to quickly and efficiently move product components or raw materials across suppliers, processing facilities, and then to distributors, retailers, and finally to customers is critical to being able to respond to customer demand, as well as in maintaining a competitive edge. As such, where the customers are has a great influence on where you source and manufacture your products.

Distance to raw materials

Generally, the further companies are from their raw material suppliers, the higher the transportation costs. The longer the distance between the manufacturing facility, the supply of raw materials and the distribution points, the more likely for freight costs to spiral up. But is this always the case? **In chapter 2, we provide some considerations on why this may not always be so.**

Good access to a transportation network

Operating a reliable supply chain requires having good access to a transportation network, which means easy access to raw materials. In the upstream side of the supply chain process, this usually involves four key forms of freight – road, rail, sea and air. In determining your site location, you also need to consider alternate modes of freight, in the event that if the ones traditionally used fail for whatever reason. What qualifies as a good transportation network will vary depending on the nature of the business or commodity involved. Throughout time, market demands will change. Naturally, supply chains will adapt to these changes to cater to the demand. This could result in new requirements for transportation which, in certain cases, could make it necessary to reassess your site location.

Availability of labor

Labor costs will vary according to where you decide to locate your production facility. Labor costs in some parts of the world are more competitive than others, but these dynamics are fast changing, especially with the advent of robotics and automation. And as economies can show rapid growth, so can the costs of labor. Nevertheless, you still need skilled labor to operate and maintain machinery, and depending on the level of automation you employ, the company will need to assess the level of skill required, the availability of it, as well as its distance to the consumer market and its proximity to other points in your entire supply chain process.

Consider competition among your suppliers

More competition among your suppliers will help to drive costs down, and drive improvements in the supply chain. In addition, organizations in some countries can be very supportive in promoting certain industries, providing very good tax breaks when you engage their suppliers.

"Arbitrage is usually step 1 in the integration process. We had suppliers, they had suppliers, and usually they are the same suppliers. We look at the volume and then go back to the suppliers and negotiate for better pricing based on volume and leverage."

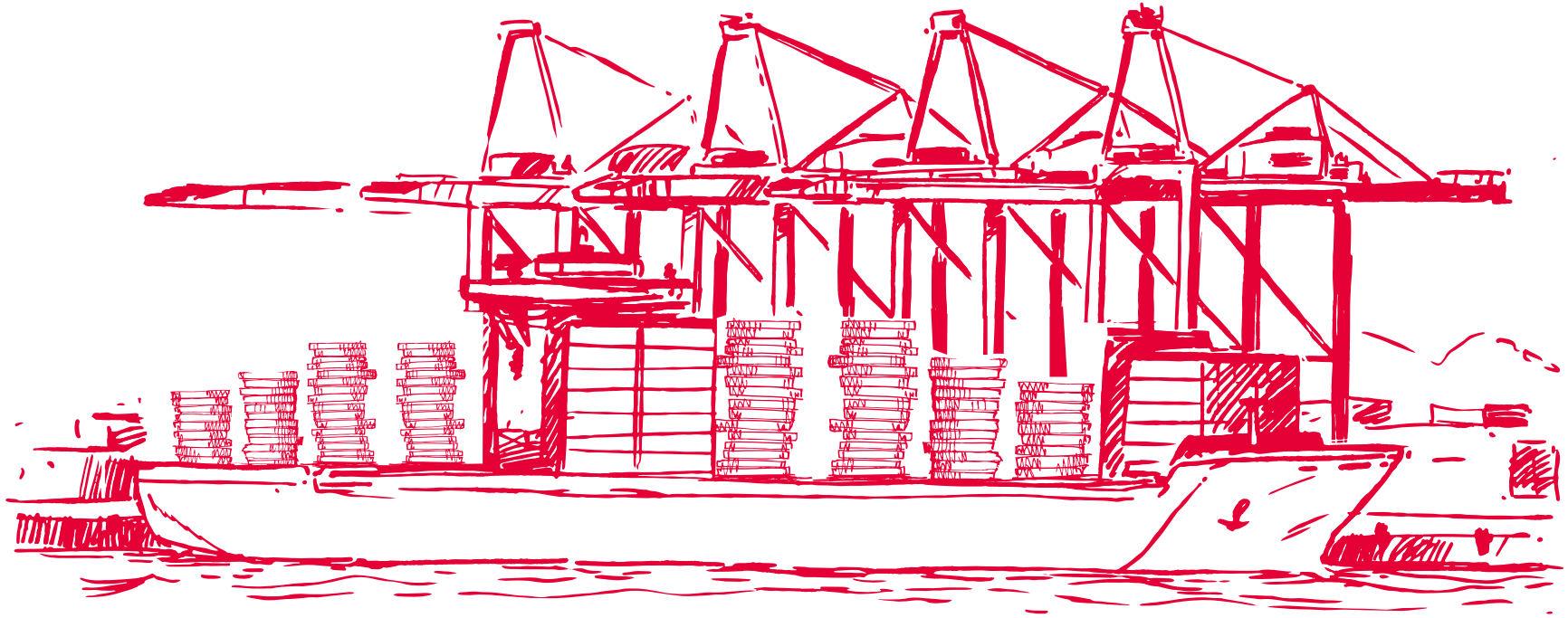
A supply chain manager from a company that recently went through an acquisition, which provided opportunities for arbitrage. Mergers can also be a sort of "industry benchmarking" of suppliers, as the company is newly acquired.

1.3 Freight costs

According to a study conducted by TU Berlin, one of Germany's largest technology universities, businesses in the industrial sector are spending 7 percent of their annual revenues on logistics. In the commercial sector, the share is nearly 16 percent.

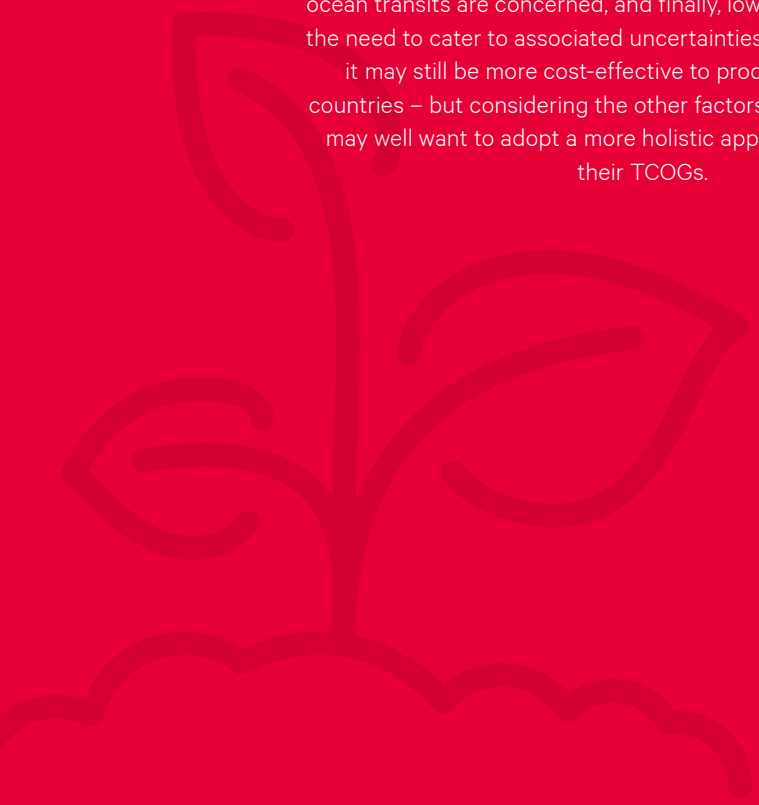
In addition, transport accounts for most of the overall costs in the supply chain – 31 percent in the commercial sector - an area where considerable savings can be achieved. Consolidating loads, bundling consignments, and optimizing the selection of the forwarder alone can lower freight costs by up to 10 percent.

A good understanding of the cost components of freight is thus really crucial to optimizing the TCOG. It is important for employees involved in procurement to be knowledgeable about carriers' cost drivers and rate structures.



Cost-effective sourcing strategies

With labor costs in many parts of the world achieving parity, the value proposition of manufacturing in Asia is slowly diminishing, in tandem with rising freight costs. As such, many companies are today near-shoring their supply of raw materials, locating them to as near to their end markets as possible. Shorter distances mean greater responsiveness to fluctuating consumer demand and lesser supply chain congestion at ports and other transit points, and thereby, an increased ability to fulfill orders. Shorter distances also mean lower freight charges, lower risks than where long haul ocean transits are concerned, and finally, lower risk exposures and the need to cater to associated uncertainties. For many industries, it may still be more cost-effective to produce in third world countries – but considering the other factors involved, companies may well want to adopt a more holistic approach to calculating their TCOGs.



Pay according to weight or space

Many or most carriers charge by the pallet. One way they have been known to optimize costs is through double stacking when there is excess capacity on a pallet with products from other clients. If companies know that their goods are only taking up half the space on a pallet, then they might want to negotiate with the carrier for half charges only. On the other hand, companies can use a carrier that charges according to weight. This may be a cost-effective option for companies whose parts or products are pretty lightweight.

Make or buy?

Outsourcing is an important strategy that can allow a company to focus on its core activities/competencies. While outsourcing is also seen as a means to reduce the TCOG, one cost exposure that is often not factored in is freight costs. It is important for companies to take into account the exact freight and logistics cost differentials between outsourcing and insourcing. After all, high freight costs can easily nullify or reduce the savings gained though outsourcing.

Use fewer carriers

Supply chain managers may spend a lot of time identifying carriers that provide the best price, according to the various locations from which the product components emanate. However, using numerous carriers to save costs may not be very smart. Besides adding to administration, in the larger scheme of things, it may in fact not be the most cost-effective way to do this. Rather, by identifying a few reliable carriers who are relatively cost-effective, and awarding them with larger volumes of work, the company may well be able to negotiate a better price, and also receive better service from them. Fuel is a key component of freight costs. It is highly volatile commodity, adding an element of risk that can have a major impact on the profit margin .

Modes of Transportation

The decision of whether to ship by air, rail, road, or sea is often made on the basis of the product life time and the product value. Short product life times can result in unwanted shipping urgencies, which can be eliminated or mitigated through accurate demand forecasting. In particular, eliminating or reducing the need for air shipments (the most costly of the four freight propositions) can have a demonstrable impact on the TCOG .

Consolidate shipments

As a principle, supply chain managers should aim to have trucks loaded to capacity – at “full truck load” (FTL) or “full container load” (FCL). While this may not always be possible, with effective forecasting, organizations may be able to reduce the instances in which shipments are less than full capacity. Over many shipments involving thousands of product components, substantial savings on total freight costs can be realized. Other benefits include shorter transit times and potentially a reduction in product damages due to fewer touchpoints.

Taxation and customs duties – have an understanding

While producing goods in overseas locations may often mean lower costs, quite often it adds other types of costs – tariffs, customs duties, brokerages and carrying costs – which can be as much as 30 percent of total shipping fees. Tariffs can vary depending on government policies about products imported into a country – the extent to which local industries provide a value-add. Case-is-point is the US where finished cars are dismantled and shipped in, to circumvent tariffs. Having a deep understanding of taxation regimes and government policies of countries can therefore help to reduce costs. If the materials are sourced from countries with high tariffs, then, this will increase freight costs, adding to the TCOG of the product.

Documentation – use automation

Freight documentation is a highly resource-intensive procedure. In the entire supply chain process, there can be as many as 200 documents for a single shipment. Mistakes such as repeated keying in of the same information, errors in manual entries, making “wrongful declarations,” or “under-declaring” the weight or freight class of the goods etc. can incur heavy penalties. Proving origin of goods is a particularly complex process as well, as different parties can contribute to the makeup of any product. The charges imposed by freight forwarders for documentation or processes can be substantial as well. Through automation, you could greatly streamline the process, avoid errors, and move personnel typically deployed for these functions to more value-adding roles.

Take advantage of Free Trade Agreements

Understanding how to take advantage of Free Trade Agreements (FTAs) can make a huge difference to your TCOG. In order to do so, you need to identify the various FTAs that are relevant to your supply chain process, ascertain if they apply to your products, if they meet the rules of origin, as well as the compliance requirement. However, proving that a product qualifies to enjoy the benefits of an FTA may not be a straightforward process. Just knowing how to take advantage of FTA opportunities can save you considerable costs .

1.4 Visibility

Managing supply chain costs and achieving operational efficiency are all about predictability. For companies to be able to effectively predict incidents, they will need visibility to information. However, in the BCI supply chain resilience report 2017, most respondents (69%) highlighted that they did not have full visibility of supply chains.

For companies to make the right decisions relating to optimizing their TCOG, they need visibility to information . However, while companies have good visibility over their own internal processes, this visibility diminishes significantly once the supply chain extends out of the company. Without a good understanding of the processes, the level of efficiency and risk management, the company's ability to improve upon them would be limited.

Decisions to optimize the supply chain are also hampered by organizational factors. For decisions in this area to have an impact on the TCOG, there should be consultations and input across functions. Unfortunately, supply chain responsibility is often relegated to the few who directly influence it. The individuals making the decisions may also not have the best access to relevant data, which is spread across the organization, and is not digitized.

An efficient supply chain process would ensure:

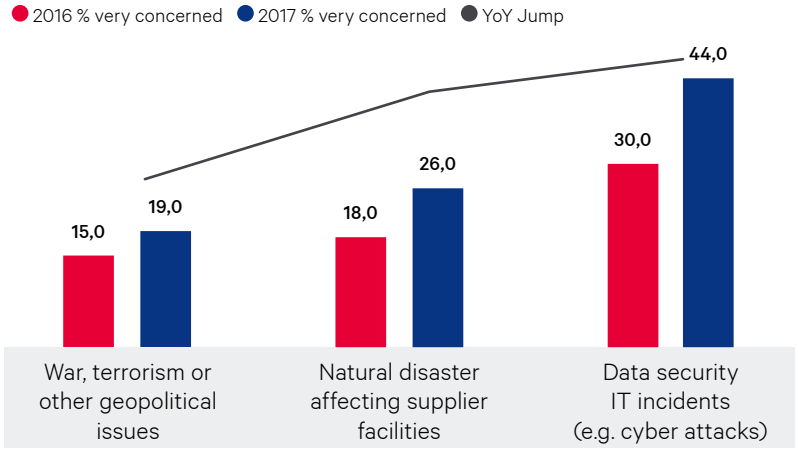
- **Optimization of the use of resources and capacities along the entire supply chain process**
- **Ensure that revenue/profits are not impacted by "out-of-stock" situations**
- **Avoidance of unnecessary costs such as last minute/emergency air freights to meet customer demand**
- **Inventories throughout the entire supply chain process maintained at optimal levels**

Potential disruptions – Assurance of supply

Considering the number of locations in a supply chain process, you can understand the various vulnerabilities – delays at customs, traffic jams, piracy, damage to products during loading, cyber-attacks, geopolitical and terrorist risks, lapses in quality control, IT and telecommunications outages, sudden weather changes, "acts of God," and others. A disruption in the supply chain at one location will have a domino effect on the entire process. In the BCI survey highlighted earlier, 65 percent of company executives reported that they experienced at least one incident that caused a significant supply chain disruption in the preceding 12 months. Unplanned IT/telecommunications outages, cyber attacks/data breaches and loss of talent/skills were the top reasons highlighted for the disruptions.

Fastest Rising Supply Chain Risk

Respondents are increasingly concerned about a variety of threats



Source: SCM World Future of Supply Chain suveys 2016, 2017 preliminary results)

While the most obvious strategy to reducing supply chain risk is to simply increase inventory, that is counter-productive to our aim of reducing the TCOG. The more enlightened approach to increasing reliability and becoming more resilient might be to incorporate a combination of strategies such as supply chain segmentation. This would allow a company to spread its risk exposure by sourcing for materials from multiple suppliers or locations, and catering to additional (not excessive) inventories at various points to compensate for potential disruptions, among others. Above all, organizations should also place greater priority on analyzing supply chain disruptions and mitigating the causes.

However, to make the right decisions in this area, companies need good visibility of the entire supply chain process. Response plans should not be formulated when an incident happens. There should be scenario planning for potential disruptions. The responses of Nokia and Ericsson to a 2000 fire in a Philips Electronics plant in New Mexico, USA, are illustrative of the importance of good visibility to relevant information and the ramifications of disruptions. The fire affected both mobile phone companies with regard to the supply of a critical component in their products. However, while Ericsson let the delay take its course, Nokia monitored the situation and took counteractions. In the end, while Nokia found a supplier in three days, by the time Ericsson took action, it had lost about a month of production and incurred a US$200 million hit to its revenue.

The data opportunity

At the end of the day, running an efficient supply chain and reducing the TCOG requires being able to minimize preventable disruptions to the supply chain, as well as being able to respond to unforeseen disruptions in an efficient manner. It is all about predictability. Data analytics has the potential to have transformative effect in this respect. Unfortunately for many businesses, resources to innovate and re-engineer have been targeted at front end functions such as marketing and to a lesser extent on the downstream side of the supply chain. The untapped big opportunity for supply chain managers is in using data analytics to create efficiencies in the upstream side of the supply chain process. In chapter 4, we will discuss the role data plays in achieving actionable insights.

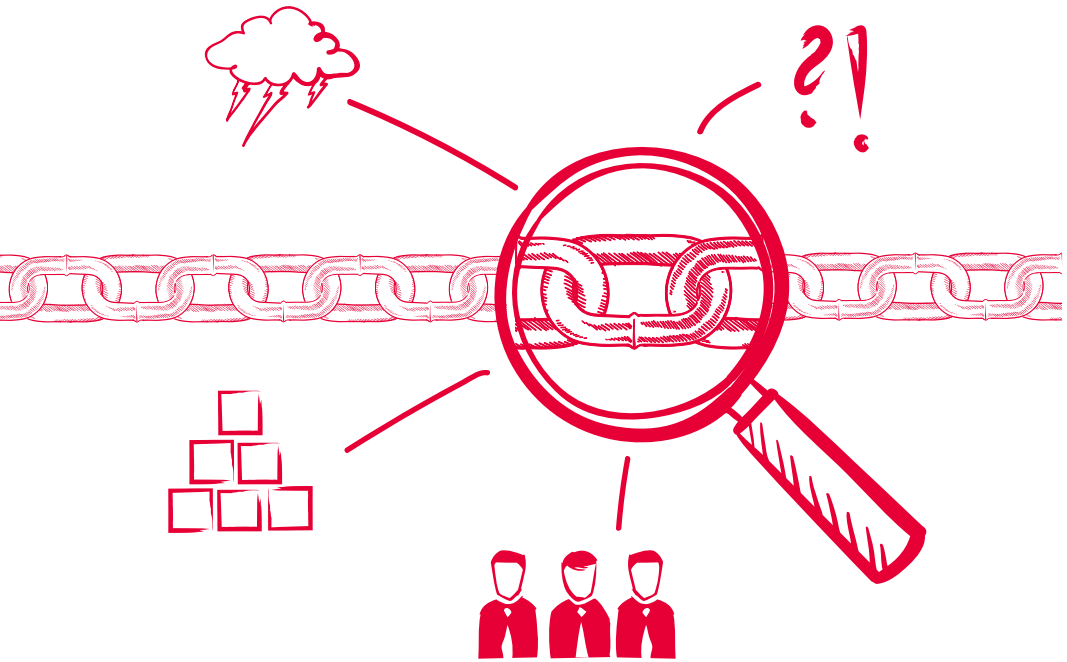
Catering to demand fluctuations

In a 2016 KPMG global survey of 360 senior manufacturing activities, more than one-third of CEOs disclosed that their supply chains lacked the speed and agility to compete with new market players. Customers are increasingly testing the supply chain's ability to deliver. A plethora of factors such as marketing or promotional activities, sudden trends or fads, media frenzy, and others could affect demand. When supply chains are not able to respond to spikes in customer demands, it can be a huge lost opportunity, or worse still, source of reputational damage. This is especially so in this day and age, when customers expect fast fulfillment, and where many companies are implementing omnichannel distribution. Instead of building supply chain agility, many companies are basing their manufacturing activities squarely on demand forecasts.

CASE STUDY

Supply chain redundancies = prudent risk management at global medical technology company BD.

Supplier diversification is a fundamental aspect of risk management at BD. The company has very robust business continuity plans. Risk management as a topic receives board level attention. The company's risk management program includes the ability to quickly "mix and match" suppliers in the event of a crisis. Business continuity planning is done at each location, for both material and electronic suppliers.



As earlier stated, the key in all of these is not to simply increase inventories, or to shorten product creation and distribution, but rather to manage and match supply and demand more accurately, and on an ongoing basis. To be able to respond either to increases in demand or to disruptions, there need to be synchronization and coordination between all the parties – and this in turn requires good visibility to processes across the entire supply chain.

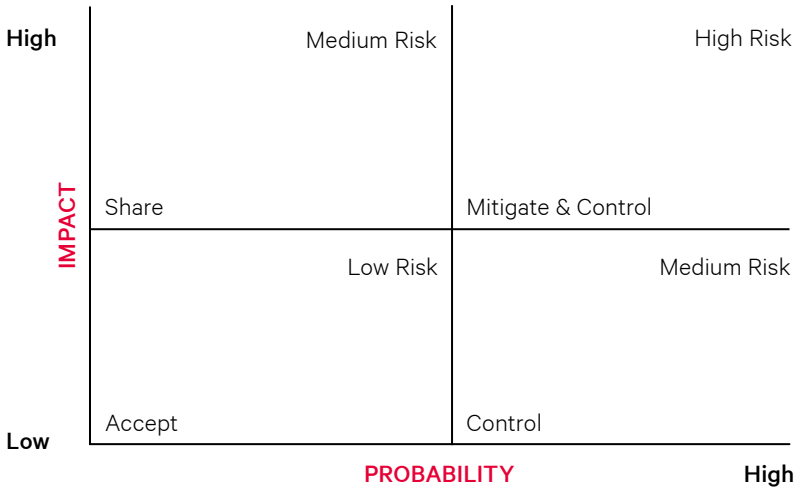
This overview should encompass the flow of goods and information and span all business partners, for end to end supply chain visibility. Taking this approach would provide businesses with a basis for better decision making, and allow them to identify potential problems in the supply chain before they occur, avoid risks, and get a handle on complexity and volatility.

However, many companies today manage supply chains in silos. This behavior is amplified by misalignment on the definition of metrics used by multiple departments. As a result, supply chain risk management has become very silo-based. Departments can exaggerate the magnitude of the risks that are pertinent to them. Management needs to look at risks from a company perspective and prioritize the areas which pose the greatest risks. Beyond the confines of the organization, some emerging resources for data include social media and sensors. For example, there could be information shared on social media about a disruption to the availability of a specific component or ingredient.

Approach to supply chain risk management

1. **Engage all stakeholders and identify potential risk exposures.**
2. **Identify and map potential risks, in terms of severity and likelihood of occurrence (see figure X)**
3. **Form strategic partnerships – i.e. supply chain specialist risk consultancy firms, data collection agencies, auditor forms.**
4. **Develop a risk management plan.**
5. **Conduct simulations to ensure that the plan is effective.**

Risk Map



Perhaps the biggest challenge today in reducing TCOG is within the organization itself – getting the various departments to cooperate and to share data. Beyond collecting and sharing, the data needs to be analyzed using the right tools and technologies. Currently, there are many bottlenecks due to legacy technological infrastructure within companies that prevent data from being accessed quickly and efficiently. But regarding this as a technological challenge is also not right. Many companies need to go through a cultural change to transcend their silos, to be able to promote organization-wide visibility, and to start talking to each other.

About this e-book

This e-book provides qualified, unbiased information on supply chain cost management. It deals with product design and manufacturing processes, technologies and corporate business management – analysed and explained by experts. It reflects current understanding at the time it is written – subsequent changes in the underlying circumstances cannot be ruled out.

The author

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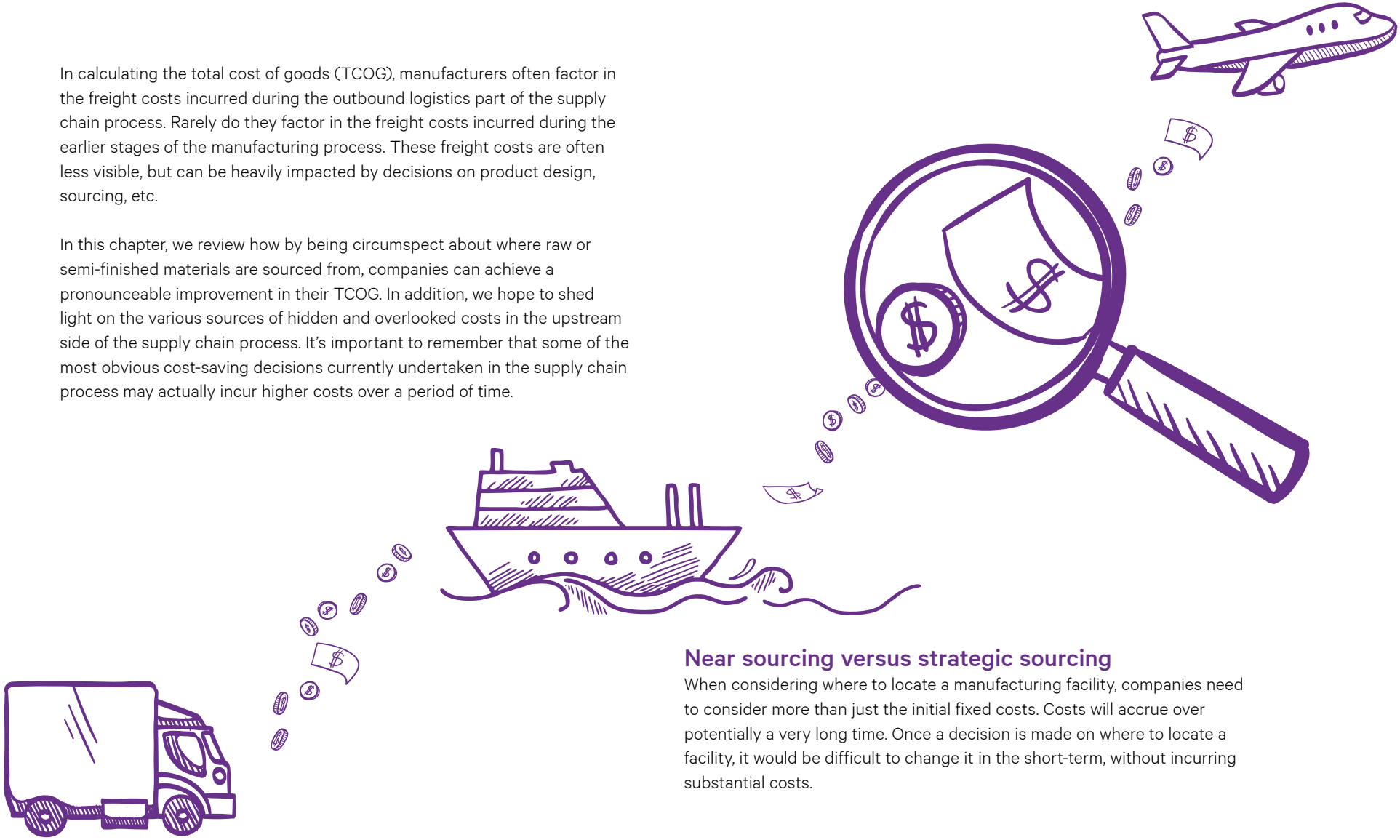
2

Reducing the TCOG through strategic sourcing

A look at the various considerations pertinent to choosing locations for sourcing and manufacturing. What are the principles behind strategic sourcing? Are there situations where near sourcing isn't the answer? How do Free Trade Agreements (FTAs) impact sourcing decisions, doing due diligence on suppliers (and their suppliers), and in following the rules of origin, among others? We also present a structured approach on how companies should undertake strategic sourcing.

In calculating the total cost of goods (TCOG), manufacturers often factor in the freight costs incurred during the outbound logistics part of the supply chain process. Rarely do they factor in the freight costs incurred during the earlier stages of the manufacturing process. These freight costs are often less visible, but can be heavily impacted by decisions on product design, sourcing, etc.

In this chapter, we review how by being circumspect about where raw or semi-finished materials are sourced from, companies can achieve a pronounceable improvement in their TCOG. In addition, we hope to shed light on the various sources of hidden and overlooked costs in the upstream side of the supply chain process. It's important to remember that some of the most obvious cost-saving decisions currently undertaken in the supply chain process may actually incur higher costs over a period of time.



Near sourcing versus strategic sourcing

When considering where to locate a manufacturing facility, companies need to consider more than just the initial fixed costs. Costs will accrue over potentially a very long time. Once a decision is made on where to locate a facility, it would be difficult to change it in the short-term, without incurring substantial costs.

Distance to raw materials

There are obvious advantages to near sourcing. When the manufacturing facility, the supply of raw materials, and the distribution points are all located near each other, freight costs will be lower and there will be less chances for holdups at customs checkpoints to cause delays in the supply chain process. However, in many situations it is not as simple as that. Sourcing 80 to 90 percent of components from one single country, even if it is further away, could well be more cost-effective than sourcing from multiple nearby countries.

A more scientific approach to determining sourcing locations it seems is well warranted. There are in fact various algorithmic techniques used in the industry to identify the optimal location, with minimizing transportation costs as an objective – see Figure A.

Location Analysis Techniques

Location factors rating technique –
This is a method employing both quantitative and qualitative factors; a wide variety of factors are considered in this technique. These factors are assigned weightings, scored, and then the weighted scores are added up to arrive at a total score for comparisons across sites.

Centre-of-gravity technique –
This formulaic method takes into account factors such as: where markets are located; volume of goods shipped there; and shipping costs (which can be based on the weight of the shipments). The various locations are placed on a map showing the relative distances between the sites.

Load distance technique –
A variation of the center-of-gravity method, this technique factors in distances to suppliers as well as the number of shipments from each. However, access to workforce, roads, markets, and taxes are all assumed to be the same, which in essence means these variations between locations are not factored in.

Beyond costs

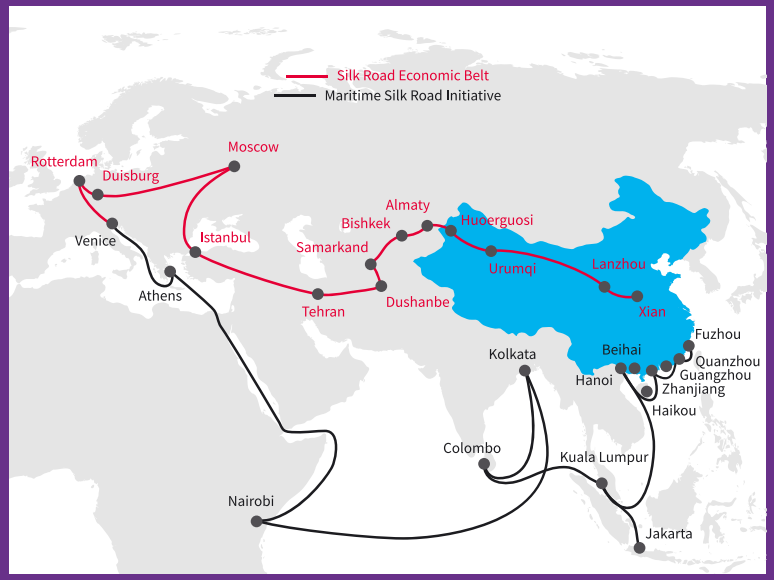
While the underlying objectives of near sourcing and strategic sourcing are similar – achieving optimal TCOG – strategic sourcing focuses on the development of mutually beneficial, longer term relationships with suppliers. Building a relationship based on trust would deliver dividends in other ways –the supplier and the customer will be willing to share critical information that are crucial to ongoing optimizations of the supply chain process over years.

Intellectual property

One risk in outsourcing is that when companies share information with suppliers, especially those located in countries where intellectual property rights are less regulated or enforced, critical proprietary information could be compromised. This could be less of an issue in cases where new versions of the product are regularly released – faster than pirates can reverse engineer them.

The Silk Road of the 21st Century

China's One Belt One Road (OBOR) initiative is an ambitious project involving 65 countries. It consists of two parts – a road and railway connecting China to Europe and a sea route that connects China's ports to various ports in Asia, Africa and the Middle East. Some analysts feel that with the current three to five times cost advantage that ocean freight enjoys over rail, only high value or time-sensitive goods will benefit from the shorter freight times over rail. On the other hand, with the emergence of new shipping routes and China investing in various port development initiatives across continents, new dynamics could well be created in supply chain. These developments may bring tremendous cost and operational efficiencies in the coming years.



Negotiating power

It is reasonable to expect that in locations where there is a confluence of suppliers, you would be able to secure a better price. Market forces themselves would also have brought down costs. On the other hand, in markets where oligopolistic conditions prevail, the handful of suppliers there may be able to keep prices high, due to closer-to-perfect knowledge of industry pricing.

Strategic raw materials

In chapter 1 we presented a case study on how a sudden supply disruption to one critical component became the litmus test for the quality of two supply chain organizations from two companies. In strategic sourcing, some raw materials are regarded as more “critical” than others – in terms of their impact on product quality, on the business, on the environment, as well as in ensuring safety/compliance standards. Critical raw materials also tend to be scarcer – supplied only by a few companies – with little alternatives available and are less easily procurable in the short-term. A strategic sourcing approach factors in risks and variables such as these, rather than reducing the supplier choice to a matter of just costs.

Costs over a lifetime

A product’s lifetime cost should also be considered. Companies need to estimate cost of components or raw materials over a product’s life, including its freight and logistics costs, customs duties expected to be incurred, accessories, spare parts, performance and quality.

Sustainable manufacturing and other intangible costs

Governments are increasingly conscious about the impact of manufacturing on the environment. To what extent does a supplier meet environmental standards – i.e. recycling, handling of hazardous materials, and adherence to safety standards? Companies that pursue sustainable manufacturing activities can take advantage of tax credits and rebates from the government. Sourcing decisions can be based on where such favourable tax regimes exist.

Also, “intangible” costs such as order processing time and efficiency vary from supplier to supplier, and from country to country. In addition, does the supplier absorb the costs of holding inventory?

End-to-end trade compliance

While many brand owners are able to gain visibility as to who their suppliers are, they might not have the same visibility when it comes to understanding who their supplier’s suppliers are, and their level of trade compliance. Trade compliance issues vary from location to location and are dependent on government policies. How do brand owners achieve the visibility that they need to ensure that they are compliant with the various trade agreements? How do they collate such data? These are issues confronting companies.

Distance versus FTAs and Tariffs

Sourcing from overseas locations may mean lower costs. But it will be wise to investigate the other costs – tariffs, customs duties, brokerages and carrying costs – which can come up to as much as 30 percent of total shipping fees. Tariffs can vary depending on whether the company creates employment for local industries -where a local company provides this kind of 'value-add' to the local economy, it may be able to enjoy preferential tariffs. Case-in-point is the US where finished cars are actually dismantled and shipped in, to circumvent tariffs. Having a deep understanding of taxation regimes and the government policies of countries can therefore help to reduce costs. If the materials are sourced from countries with high tariffs, then, this will increase sourcing costs, adding to the TCOG of the product.

> **The question of how you deliver with the lowest cost used to be answered too easily – companies looked at material costs, and many outsourced to emerging markets. But they realized very soon that it wasn't that easy. It took two months to get the cargo, there were quality issues, freight costs went up... all of which had a big impact on the TCOG."**
>
> A supply chain executive from a major machinery equipment manufacturer

Free Trade Agreements (FTAs) are intended to help businesses. Import duties, which can be much as 20 percent are reduced to zero for companies that take advantage of FTAs. In addition, duties on imports can be completely waived or paid just once. By taking advantage of FTAs, businesses can also leverage technologies or specialized talent where they are located.

Yet, despite these opportunities, the majority of companies are not seizing the opportunities that FTAs present to them. In a 2016 KPMG survey , more than three in four trade professionals disclosed that they were not fully utilizing all FTAs available in their country and applicable to the products they were manufacturing. Complexities in the rules of origin, challenges in gathering required documentation, and lack of internal expertise were the reasons cited for the poor take-up.

Dealing with complexity

Businesses' reluctance to take advantage of FTAs is understandable to some extent. There are more than 400 FTAs around the globe, each of which may well be more than 500 pages of legal minutiae. Sieving through all these complexities, coordinating with multiple parties, and putting in place the necessary documentation to take advantage of FTAs may seem like a monumental challenge.

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https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2016/10/2016-global-trade-management-survey-from-thomson-reuters-and-kpmg-international.pdf

The duty of identifying FTA opportunities usually falls upon the trade compliance function within companies. However, considering the amount of information that needs to be sieved through for every single FTA, a case could be built for consolidating this function.

Visibility to data and automation

An overload of information seems to be a problem encouraging inertia on the one hand. On the other, there is a lack of visibility to which FTAs itself can be resource-intensive. Also, benefits from FTAs are just one factor influencing sourcing decisions. Companies need to consider the other repercussions from shifting sourcing locations – i.e. How will the production schedules be impacted? Will it contribute to higher demand/supply unpredictability? Would the company have to incur higher inventory carrying costs?

Data analytics or artificial intelligence, can certainly address this. But it is estimated that by the end of 2020 only a third of manufacturing supply chains will be using data analytics-driven cognitive capabilities . Companies by and large are also not using specialized software to identify and maximize opportunities that FTAs present.

An ideal software solution should among other things, fulfill the following:

- **Query and identify FTAs a company can take advantage of**
- **Qualify products for FTAs**
- **Automate certification processes**
- **Automate the qualification bills of material (BOMs) amongst multiple free trade agreements**
- **Automate supplier certifications/enable suppliers to create certificates**
- **Validate import documents and transactions across all checkpoints**
- **Function as an easy to access repository of records, facilitate auditing**

Achieving visibility

When it comes to the complex world of optimizing supply chain costs, visibility – to data collection, analysis of information, and forecasting – is the number one challenge. Companies that do achieve this stand to reap tremendous benefits, in the form of better margins, a more responsive supply chain, and better supplier relationships. Yet, when it comes to a discussion on visibility to costs, TCOG is often seen purely in terms of a product's individual cost components.

Even if supply chain managers have an enlightened view to this, to date, they have been hamstrung into inaction by fragmented data repositories across enterprises. Typical problems associated with visibility to data include:

- **An un-strategic view to data consolidation and analysis.**
- **Supply chain data resides across multiple systems, in too many formats, across business units, and geographies.**
- **Data is not communicated in a timely fashion or input into systems at all.**
- **Supply chain networks are evolving quickly – systems are not updated or are being bypassed.**
- **Lack of ownership/designated individuals or resources dedicated to it.**
- **Owners of systems have poor supply chain visibility.**
- **Data quality management is poor or lacks emphasis within the company.**

Analytics Structure

Profit Loss Level

Analysis at a profit loss level

- Evaluating the company balance sheet
- What are the cost components and their composition of the TCOG?:
  - Purchasing (Material cost/ supplier location)
  - Engineering (Design/ sourcing)
  - Freight costs

Facility Level

Analysis at a facility level – across material spend and facility

- Variances in transporting
  - For each raw material
  - From each location
  - Seasonal cost variations

Product Level

Analysis at a product level

- Assess relative % costs of transporting specific components
- Analyze according to location
- Review length of supply chain (km/miles per unit)

Transport Mode Level

Analysis at a transport mode level

- Review length of transportation by commodity
- Review ocean vs air vs rail vs truck in terms of km/miles, volume and from quarter to quarter
- Input data into freight dashboard for analytics

Strategic Sourcing

Arrive at Strategic Sourcing Decision

- Arrive at Strategic Sourcing Decision
- Cost vs. speed analytics in terms of procurement approaches:
  - Basic procurement
  - Speed sourcing
  - Strategic sourcing
- Identify existing problems, opportunities for resolution as well as TCOG optimization and create solutions

Identifying the hidden and unanticipated transportation costs
Having visibility to the full range of cost components is a central issue in achieving TCOG optimization. Costs could include expediting fees, fuel surcharges, handling charges, brokerage fees, rate increases, customs duties, insurance policies, as well as fines/penalties for late deliveries, invoicing etc. In each of these areas, there are many variables. For example, customs duties vary depending on product classification. If there is an under declaration or a wrongful declaration, you could be handed a hefty fine. Having visibility to all of these costs is essential to optimizing costs as well as to your sourcing decisions.

Despite the complexity of costs, supply chain managers have been content to put all transportation costs on the upstream side into one lump sum. No one really takes the initiative to critically review costs. In many organizations, the various people overseeing processes are not connected to each other and make decisions in an independent manner. One critical reason for this could be the lack of key performance indicators. Supply chain managers are not performance measured for achieving efficiencies, especially in achieving freight cost optimizations.

Finance and compliance costs
Finance costs typically include payment terms, changes in currency exchange rates and fees, inventory carrying costs, insurance, and financing fees. In the last two decades, governance issues have been thrust into the limelight, with the resultant net effect being an increase in compliance costs, in tandem with increasing regulations and regulatory pressure. Compliance costs typically include regulatory reporting expenses, legal fees, and fines. It is increasingly also on the onus of businesses to be circumspect about their choice of suppliers – to choose suppliers with quality compliance regimes of their own, as an additional safeguard to good governance on the part of business.

Quality of components
In their pursuit of profitability, companies often don't factor in the quality of the components, which can lead to all kinds of costs down the road, in the form of warranty claims, product returns, inspections, lost sales, and in the worst-case scenario, product recalls, liability claims, and the resulting reputational damage. The principles of strategic sourcing dictate that in choosing your supplier, you consider these factors. Collating and analysing the data relating to quality issues (i.e. where returns take place, reasons for the returns, what components cause the product failure etc.) could be instrumental in addressing quality issues at the source where they originate.

Create a roadmap for decisions
At the end of the day, having visibility to all the cost components should also be a way to drive action. Businesses should put in place a framework or road map to ensure that costs remain optimised and review them periodically. This framework should consist of the following stages:

1. **Identify the various elements of the TCOG in the upstream side of the supply chain.**

2. **Develop a framework for the collection of data.**

3. **Develop a detailed template for the collection of competing supplier quotes, as well as all the various cost components – cited above.**

4. **Factor in internal costs.**

5. **Compare quotes, negotiate and decide on the right suppliers.**

Considering the amount of data that supply chain managers need to have oversight of, the entire process could be greatly enhanced through data analytics or software. There are commercially available cost modelling software products that provide analyses of costs relating to production, labour, material, and other factors, to arrive at an estimate on profits. With the right data, it could be exactly what is needed to automate sourcing decisions in a scientific manner. Modelling software are already driving decisions in many areas, and while supply chains around the world have yet to embrace them fully, we do envision a future where modelling plays a big role.

About this e-book

This e-book provides qualified, unbiased information on supply chain cost management. It deals with product design and manufacturing processes, technologies and corporate business management – analysed and explained by experts. It reflects current understanding at the time it is written – subsequent changes in the underlying circumstances cannot be ruled out.

The author

AEB empowers businesses to evolve with the times, continually reinvent themselves, and transform powerful ideas and business models into reality. Providing cloud-based software that brings global trade and logistics together – software that is already helping over 5,000 businesses.
Beyond that, AEB wants software to make a positive contribution to society: By making supply chains leaner and greener, more secure and equitable.

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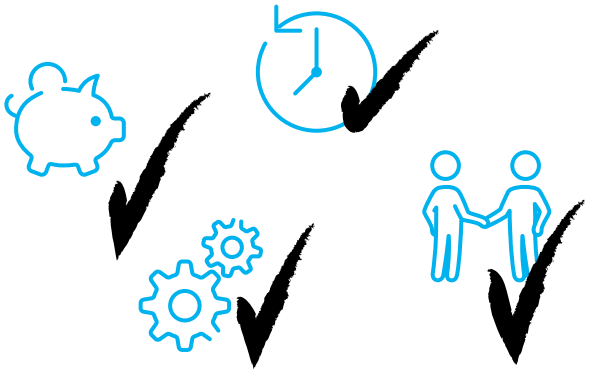
3

Impact of Emerging Technologies on the Supply Chain and Product Costs

The Internet of Things (IoT) and 3D printing – two key technologies impacting supply chains and freight cost management. We evaluate the importance of creating data visibility at the product design level and the opportunity it creates to reduce freight costs. In addition, we explore the need for visibility through IoT at the procurement stage – a further avenue for companies to manage supply chain and freight costs.

In the coming years, two emerging technologies could have a profound impact on upstream supply chain processes: The Internet of Things (IoT) and 3D printing, also known as additive printing. We could be at the precipice of a major overhaul of supply chain processes around the world, creating new cost-efficiencies, streamlining operations, improving time-to-market, upending existing relationships, and basically forging closer connections between things , people, their needs, and the methods of fulfilling them.



Embracing new technologies

Skeptics to these new technologies cite various reasons such as lack of standardization where it relates to IoT, or expenses where it relates to 3D printing, to underscore why they will not take off, at least not just yet. Years ago, tech analysts at Gartner placed 3D printing and IoT at or near the very top of its “hype cycle” – at the “peak of inflated expectations.” Gartner’s intent though was not to discredit the potential of these technologies. Rather the intent was to rein in overly exuberant expectations. Gartner estimated that it will be five to ten years before 3D printing and IoT achieve what it calls the “plateau of productivity.”

After all, we remember how the Internet went through a similar cycle, going through the now infamous dotcom bust before achieving ubiquitous status. Few would have envisioned then that internet-based artificial intelligence, robotics, and software would be running factories, yet that is the very future we are accelerating towards or have already migrated to in many sectors.

Market estimates for IoT and 3D printing are not to be ignored. According to one report by DHL and networking giant Cisco , 1% of all physical objects with connectivity potential are linked. That may seem like a small figure until you realize that that accounts for 15 billion objects. By 2020, Cisco estimates that some 50 billion items will be connected, and the number will continue to grow. The report was unequivocal about the impact that IoT will have on the logistics industry: “Companies will enjoy unprecedented visibility into operations, enabling new sources of value… this visibility, in turn, will transform how logistics providers make decisions, including about how goods are stored, monitored, routed, serviced, and delivered to customers…” Rob Siegers, president for global technology at DHL Customer Solutions & Innovation, estimated that IoT will represent US$1.9 trillion in ‘value at stake’ for the logistics industry over the next ten years.

[1]http://www.dhl.com/content/dam/Local_Images/g0/New_aboutus/innovation/DHLTrendReport_Internet_of_things.pdf

According to PriceWaterhouseCoopers, the 3D printing market size was US$5.1 billion in 2015[2]. An estimated 500,000 printers were shipped in 2016, and this figure is expected to grow to 5.7 million by 2019, with sales estimated at more than US$14.6 billion, according to Gartner[3].

Currently, several companies have implemented 3D printing. General Electric has started using the technology to produce jet engines, medical equipment, as well as home appliances. Other companies in the aerospace and defense industries, such as Boeing, Lockheed Martin, Airbus, and NASA have all ventured into it. Household names such as Ford, Nike, Bosch, Hasbro, and Hershey's are also laying the groundwork for products to be manufactured through 3D printing. There are obvious efficiencies to be reaped from the implementation of 3D printing.

Insofar as emerging technologies such as IoT and 3D printing stand to provide early adopters with competitive advantages, in the form of lowered costs of raw materials, faster fulfillment of orders, more manufacturing processes, or optimization of freight costs – all of which accrue to the total costs of goods (TCOG) – companies would be well served to investigate and exploit the opportunities they present, faster than the competition can. Many companies have become early adopters, and if we consider that these companies are at the forefront of their respective industries, the future may well already be scripted. Let's now take a closer look at how these two technologies stand to impact industries.

How IoT will enable

The potential of IoT is that previously unconnected objects can now be connected through embedded technologies such as sensors and microprocessors, and wireless technologies such as Wi-Fi, RFID, Bluetooth, or networks such as 4G. These once "dark assets" can not only be tracked and monitored by humans but are also communicating with each other, bypassing the need for human decision making in some cases.
IoT is already in operational use in some supply chains, and with falling prices of its components, faster wireless networks, and benefits from data analytics, is expected to become more prevalent. We present here a few ways in which IoT will have a transformative impact on supply chain processes. As with many things, the opportunity to achieve cost efficiencies will be the driver for adoption.

[2] https://www.strategyand.pwc.com/reports/future-spare-parts-3d

[3] https://blogs.gartner.com/pete-basiliere/2015/09/29/3d-printer-market-sales-will-exceed-14-6-billion-in-2019/

Monitoring and tracking

The potential of IoT is that it allows supply chain managers to track and monitor the status of all assets. Real-time information and the ability to anticipate disruptions to the supply chain will facilitate faster decision making to mitigate risks. For example, organizations will be able to monitor if changes in temperature or humidity levels affect products that are in transit or storage. Based on this data, supply chain managers can then improve packaging to reduce damages, contributing to a lowering of the TCOG over the longer term.

Product Design

In fact, as the value of IoT gathers traction, engineers will need to start factoring in connectivity at the product design stage. This is already happening in industries such as automobiles and aerospace. One of the more positive impacts of IoT is a more synergistic working relationship between various engineering departments – the mechanical engineers, electronics engineers, software engineers, as well as the communications engineers – all of whom have been used to working in silos. IoT is forcing product design to be a more integrated process across disciplines, forcing functions to understand the interdependencies between components better, contributing to an overall more optimized design. There will be less likelihood for product modeling itself to go back to the drawing board, because the model was later discovered to not fit the requirements of a specific discipline.

Traffic and fleet management

Freight costs constitute one of the biggest components of the TCOG. IoT can make a significant impact in this area by optimizing howoptimizing how assets are deployed. Freight vehicles that are enabled through telematics (automated intelligence for navigation, communications, safety, and security) will mean optimized routes, lesser human errors, and lesser repairs. In addition, connected vehicles can facilitate overall better coordination, organization and integration of the fleet, reducing wastage of resources.

Better workflow management

Overall, IoT will facilitate better workflow management across the entire supply chain process through better visibility, real-time information on the status of products, as well as on the various assets used to produce or transport them. It enables predictive and pro-active supply chain management and minimizes the need for a reactive approach. IoT will facilitate better planning, accurate documentation, more streamlined processes and overall cost savings

Smarter warehouses

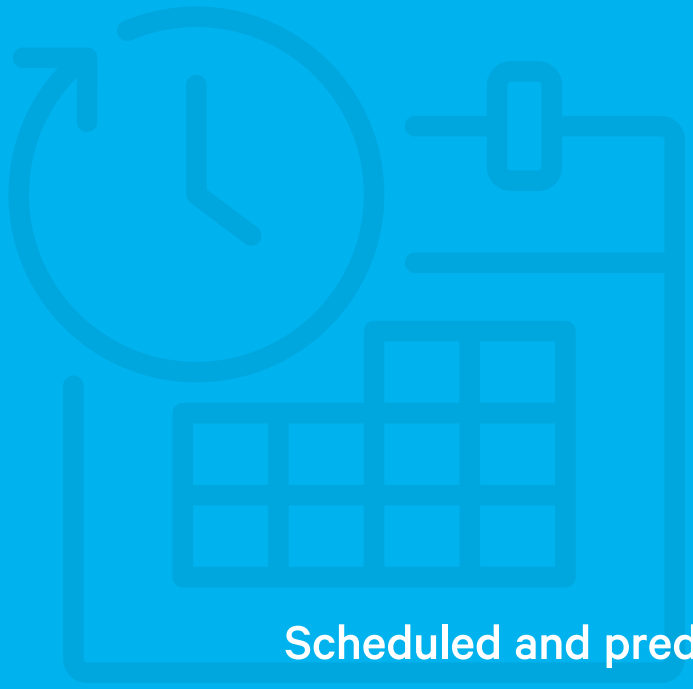
Warehouses are filled with dark assets - pallets, forklifts, shelves and other items. Connectivity can transform these objects by converting them into intelligent assets. Through low-cost, identification technologies such as RFID, pallets and objects can be tagged, paving the way for smarter inventory management. In this new ecosystem, connected objects will be monitored by personnel empowered with data. This in turn can facilitate predictive maintenance, better product management, and asset utilization, all of which have an impact on the TCOG.

Data analysis/big data

Perhaps the biggest value to supply chain managers from IoT is the wealth of data that previously dark assets now stand to provide. Supply chain managers or data analysts can review data to capture insights such as trends and seasonal peaks or lows and unlock new operational efficiencies. Based on historical data, predictive analytics will enable more accurate forecasts across the entire supply chain including demand for raw materials. Warehouse managers will be able to anticipate the extent to which assets are likely to be over- or underutilized and adjust production schedules accordingly.

Digitizing data will allow it to be easily shared, allowing the various parties involved in the entire supply chain process to be better informed, and able to coordinate with each other. It is worthwhile to remember that data can take many forms – videos, voices, images, data from global positioning systems (hence the term "big data"), all of which can now be analyzed, to yield an unprecedented level of insights about what is really happening throughout the supply chain process.

While big data is an appealing concept, executives we spoke to highlighted that too much data, especially if it is not presented in a meaningful way, will not have the transformative impact that we expect of it. Lack of standardization in the industry is another issue – in terms of how the data is presented, as well as the disparity in enterprise resource planning (ERP) systems that hold it, preventing meaningful analysis. In addition, there is today a general lack of focus on in the make stage of the supply chain, in not only collating data, but in fostering greater collaboration between manufacturing and procurement.

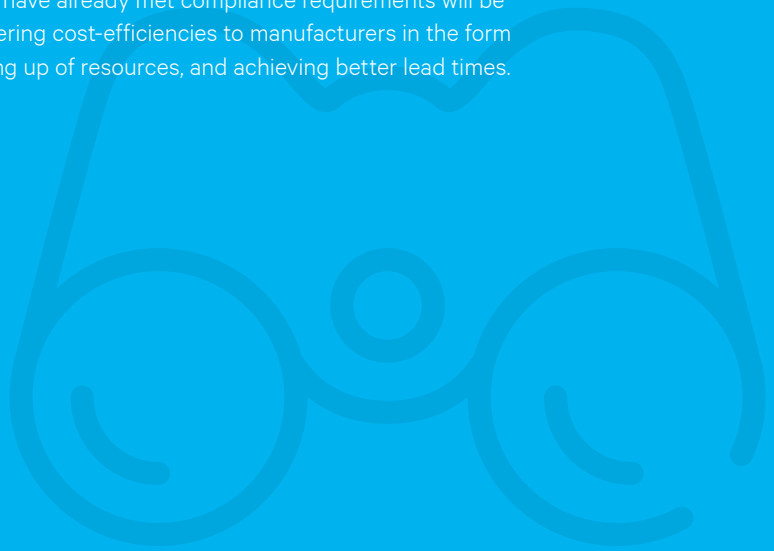


Scheduled and predictive maintenance

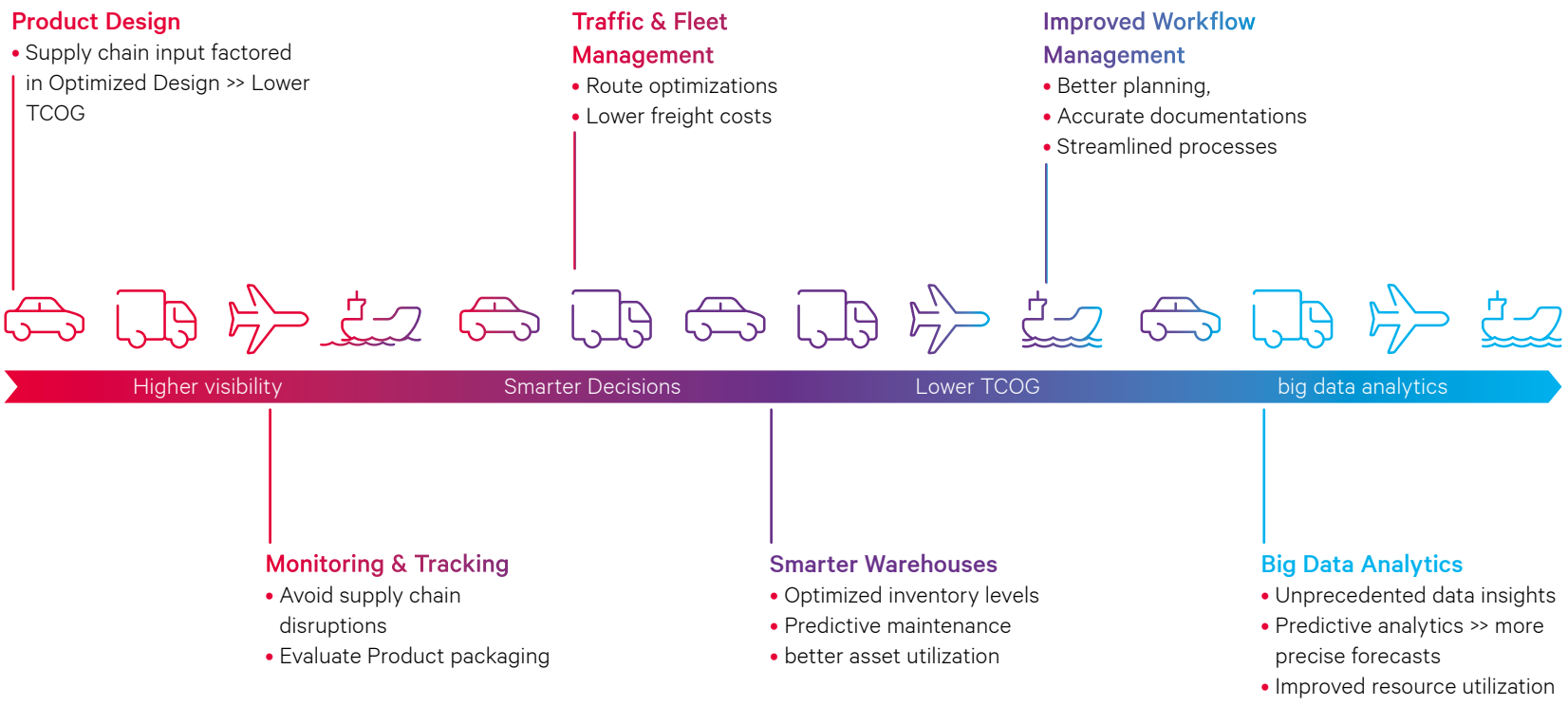
Machines don't make 'mistakes'. They do what they are programmed to do. Where it relates to maintenance of parts, software can be programmed to prompt maintenance teams on when a product is due for a visit, which is already in widespread practice – just think of your photocopier servicing. However, beyond that, the value of connected machines and data analytics is that they can predict when a product is about to fail. This can save companies millions of dollars, in preventing unplanned downtimes, expensive urgent maintenance jobs. It also allows timely ordering of spare parts and other materials used for maintenance, which add to freight cost savings.

A higher level of visibility

With IoT, and digitization of data relating to supply chain processes, management software will become increasingly important. Enterprise Content Management (ECM) systems will facilitate better document accuracy and end-to-end management of trade and freight content. ECM will also enable information relating to freight shipments to be accessed over the cloud and through mobile devices. All of these will contribute to an increasingly connected, transparent, digital workplace where regulatory compliance is greatly facilitated. There will also be efficiencies – for example, suppliers who have already met compliance requirements will be able to self-certify, delivering cost-efficiencies to manufacturers in the form of lower duty fees, freeing up of resources, and achieving better lead times.



Supply Chain Impact of IOT

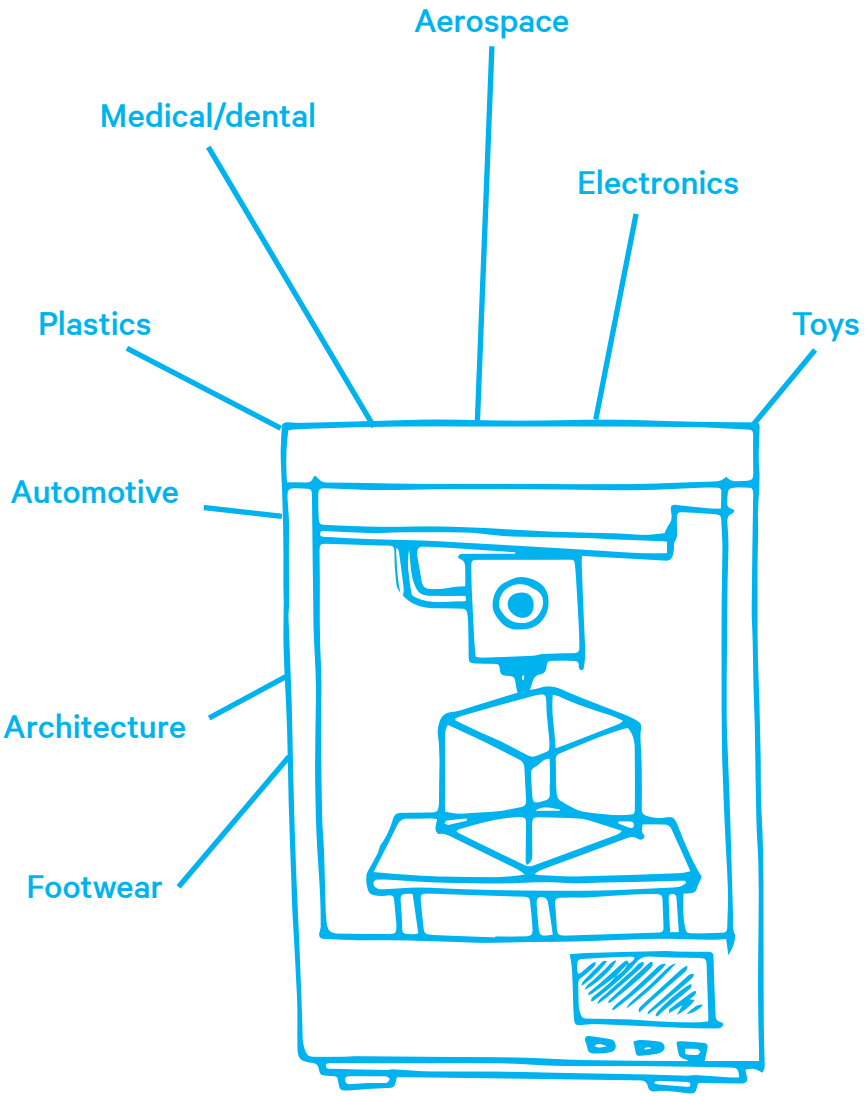


The promise of 3D printing

Pundits differ in their assessments on how 3D printing will affect manufacturing. On one end of the spectrum, there are those who say that in a matter of a few years, 3D printers capable of large volume production will make economic sense for even the most standardized parts. On the other end are skeptics who say that 3D printing will not be employed for mass manufacturing any time soon. This group believes that for the foreseeable future, 3D printing will continue to be used only to produce the most complex and customizable products and parts, or for prototyping only.

The real promise of 3D printing is its versatility – to usher in an era of customization that the world has not seen before. It represents a massive paradigm shift from established thinking and behaviors, and if the techno-optimists will have it, threatens conventional mass production itself. If they are right, and we do see a future where 3D printing permeates every sector, then what we can expect is for worldwide transport volumes to shrink dramatically, with manufacturing activities located much closer to customers. This will portenda rewriting of existing supply chain processes and logistics.

Thus all companies in the transportation business, whether, air, ocean, rail or road, should be watching the progress of 3D printing closely. The freight industry should be rationalizing about which sectors will account for the biggest areas of lost. They can do this by identifying the industries which are currently being transformed or stand to be radically transformed in the near- to mid-future. As it stands, the automotive, medical/dental, aerospace, architecture, footwear, toys, electronics, and plastics industries are the ones undergoing change.



Impact of 3D printing on industries

Impact on freight costs

The welcome thing for companies is that 3D printing can create considerable savings in time and money, because of the shorter travelling distances. However, logistics/3PL companies have reason to be wary. There are studies that indicate that total spends on transportation can be reduced by as much as 90 percent – a significant loss of revenue. But some, like UPS, have been proactive - turning its airport hub warehouses into 3dD printing factories. Instead of dedicating real estate to shelving for inventories, logistic companies can focus on offering value added services – which could well be a more profitable proposition than traditional freight or warehousing services.

Use for prototyping

When 3D printing was first invented, it was called rapid prototyping with good reason. In earlier days 3D printing was heavily used for creating prototypes and still is today – constituting about one-third. Its value for prototyping is apparent – companies can quickly test a product idea and refine it faster, without having to send it elsewhere to be built. Prototyping can be done by the originators of the idea, who can tinker with it to perfect it. The same advantages in terms of cost and speed can also be realized for tooling efforts. The technology can be used to fabricate the custom tools to produce the product. In short, 3D printing stands to speed up time-to-market and shrink development time dramatically. All these efficiencies will ultimately accrue to the TCOG.

Addressing Inventory inefficiencies

Around the world, companies hold hundreds of millions of components to support the production of goods. To maintain supply chain responsiveness to market volatility, they need to buffer for additional inventories, including of parts that are rarely required. Excess inventories have been estimated to exceed 20 percent. These are product parts that are produced but which are not used and for which storage space is allocated. But they add to the TCOG nevertheless. 3D printing addresses this inefficiency by enabling print-on-demand, which has implications for the entire supply chain network –3D printers could be located at various points, either at warehouses or distribution centers. Instead of shipping parts to logistics service providers (either owned or third parties), they can be hired to print and deliver them, entirely eliminating transport charges.

Near sourcing versus strategic sourcing

3D printing introduces a new dimension to the near sourcing versus strategic sourcing debate. In traditional manufacturing processes, parts are of a fixed shape or structure. For example, in the metal industry, iron ore can be processed into either rolled steel, double-T steel or a steel structure. As this is a time-consuming process, the processing site is often located closer to where the product is to be assembled. However, in 3D printing, metal powder becomes the real component, allowing the processing site to be located nearer, saving tremendous costs.

Facility location

Companies wishing to implement 3D printing will have to answer a range of questions relating to where they locate their facilities: Should the printing be done at factories or at distribution centers located near their markets? What are the costs relating to labor, materials, energy, and shipping in the locations they choose? Are foreign exchange rates favorable in these locations? To the extent to which companies opt for a more decentralized approach to embedding 3D printing in their supply chains, the answers will increase in complexity, placing greater focus on the importance of optimizing supply chain efficiencies.

When will 3D printing become mainstream?

One of the biggest hurdles to 3D printing is that for it to find mainstream adoption there will need to be an unraveling of current conventional manufacturing and supply chain processes. In their research, Christian Weller, Robin Kleer and Frank T Piller, argued that 3D printing will only become mainstream when it met four market principles: versatility of the manufacturing machine, customization and flexibility for free, complexity for free, and reduction of assembly work.

To the list of criteria above, we can also add: availability of 3D printable material. Currently, the types of material available for 3D printing are restricted to plastics, certain types of ceramics and metals. 3D printers haven't reached the level needed to be able to print an extensive range of material types that are used to make the products we find around us. However, the sophistication of 3D printers is improving.

And the transformation, while yet to gather acceleration, is already underway in healthcare and medical, automotive, aerospace, and in some parts of the retail, and sports industries. What is the one commonality across these sectors? It is the ability to customize products. In industries such as the hearing aid industry, the transformation is total – 3D printing has eliminated all other production methods – a change that happened in less than 500 days. Companies will be advised to bear in mind that the cost of waiting too long can be high.

About this e-book

This e-book provides qualified, unbiased information on supply chain cost management. It deals with product design and manufacturing processes, technologies and corporate business management – analysed and explained by experts. It reflects current understanding at the time it is written – subsequent changes in the underlying circumstances cannot be ruled out.

The author

AEB empowers businesses to evolve with the times, continually reinvent themselves, and transform powerful ideas and business models into reality. Providing cloud-based software that brings global trade and logistics together – software that is already helping over 5,000 businesses.
Beyond that, AEB wants software to make a positive contribution to society: By making supply chains leaner and greener, more secure and equitable.

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Digitization of Supply Chains
The opportunities being overlooked

How organizational cultures need to evolve to take advantage of digitalization and supply chain visibility. We present case studies and best practices on some companies that are at the leading edge in this respect and also recommend a systematic, data-driven approach to analyzing freight costs.

Digital technologies are revolutionizing processes. The one area where this change has not been holistically embraced has been in supply chain and logistics. While digital automation and software systems are being implemented in specific areas in a piecemeal fashion, they are not having the same transformative impact that they are having in other sectors. However, as change is happening everywhere else, even in this area progress cannot be stalled indefinitely. Eventually, change will be forced. Case in point is how one emerging technology – 3D printing – revolutionized the hearing aid industry in the US in just 500 days – practically in a blink of an eye as manufacturing transformations go. Today there is no company in the US hearing aid industry that does not utilize 3D printing.

Can such a radical change happen in other industries? The possibilities are there certainly – ultimately, when both opportunities and costs combine to force change, companies will be left with little choice. The annals of business history are filled with case studies of companies that have failed to adapt to new trends and innovations and ended up paying the ultimate price. In our surveys of companies, supply chain managers have expressed how companies are influenced by "larger priorities" such as meeting top and bottom line objectives from a quarter-to-quarter basis. Visionary thinking seems not to be the prerogative of supply chain executives

The companies that may well pay the highest price when change happens will be the ones that are most resistant to change, especially if it is sudden. One key reason for this resistance to change is that information is held in silos, often due to different needs for data by different departments. To consolidate the data and harness their potential, companies must be willing to breaking down barriers.

In this chapter we review some of the digital trends that stand to create new cost-efficiencies in supply chain processes. It is natural for these changes to be seen as threats – yes, jobs will be lost, but emerging technologies also present opportunities – for companies to streamline supply chains, to achieve reductions in the total costs of goods (TCOG), to achieve competitive advantages. We will also review the pivotal role that leadership needs to play in evolving their company cultures to be more progressive.

Technologies driving change

The technologies that are expected to shape future supply chains can be classified into several key areas. It is worth highlighting that the profundity of their impact is not in their independent adoption (as is currently happening across supply chains), but in combining and integrating them, through machine-to-machine communication.

Internet of things/sensors and trackers:

technologies such as radio frequency identification or Bluetooth tags, coupled with wireless communications will allow companies to track a range of things – location, temperature/humidity, vibration, pressure, inventory levels, equipment status and others, to yield a wealth of information that will help supply chains monitor their inventories, reduce damages to packaging, ensure inventory levels are kept at sufficient levels to meet supply and demand volatility and in general, optimize resources. The Internet of Things (IoT) will also usher in greater shipping automation and enhanced supply chain integration.

Big data analytics/digitization:

as data relating to supply chains gets digitalized, it will enable organizations to run analytics of all sorts – for demand forecasting, advanced procurement, optimization in transport routes and capacity. There is data to be gleaned from every step in the supply chain process, which when accumulated analyzed, can provide insights to optimize the entire chain.

3D printing:

with increasing sophistication and affordability, 3d printing can be expected to contribute to a major decentralization in the supply chain process, as well as to meet on-demand fulfillment of component requirements. Cost savings from reduced dependencies on freight and storage, along with efficiencies in production will be irresistible to companies and new configurations in supply chains, product locations, as well as raw materials used will emerge.

Robotics:

all types of repetitive processes and tasks stand to be replaced by robotics and automation. Tasks such picking up or delivering raw materials, unloading, palletizing and assembly work stand to be robotized.

Blockchain technologies:

the defining characteristic of blockchain technology is that it is a distributed ledger – data on transactions or movements can be seen in real time by anyone with an interest in it. This close-to-perfect transparency creates considerable accountability, visibility to the big picture, as well as to the small details. Blockchain technology makes possible smart contracts, where data on deliveries, shipment location, etc. are updated real time with all interested parties having access to it. This eliminates the need for humans to make data entries, which can be delayed or prone to errors.

Cloud technologies:

the promise of cloud technologies is that applications, information systems, and business processes are able to interact, providing supply chain executives with real-time access to information across the entire process, anytime, anywhere. While this has remained a pipe dream, placing data in the cloud will allow these platforms, through a series of emerging protocols and standards, to be integrated, facilitating end-to-end collaboration.

Augmented reality(AR)/virtual reality (VR):

AR and VR technology could revolutionize human behaviors, allowing employees to perform tasks more efficiently. Aided by devices already in the market like Google Glass or Microsoft's HoloLens, personnel in the supply chain industry will receive real-time updates anywhere. As they are walking through a physical space such as a warehouse, they can assess statuses of materials or spaces just by looking at them. Completeness checks, picking up products or supplies, traffic updates, freight loading, navigation – all of these functions stand to be enhanced by AR and VR.

Artificial intelligence (AI):

Perhaps the technology that is likely to make the most profound impact on supply chains is AI. This is because, in essence, AI is intended to replace humans. Possibilities include: chatbots which address trivial supplier queries or make purchasing requests; machine learning technology for algorithm-based decisions on inventory levels, forecasting etc.; autonomous vehicles for more cost-effective and accurate logistics; and natural language processing (NLP) to mine previously untapped data from foreign languages.

Supply Chain Impact of IoT Technologies

Internet of Things
- Mobile access to real-time data
- Shipping automation
- Supply chain integration
- End-to-end supply chain visibility

Sensors & Trackers
- Location monitors
- Assess packaging quality (humidity, temperature, shocking)
- Inventory levels
- Equipment status
- Route optimizations
- Resource optimizations (i.e. pellets, containers etc.)

3D Printing
- Production locations
- Production materials
- Logistic & process reconfigurations

Big Data Analytics
- Predictive analytics
- Inventory/component optimization
- Route optimizations
- Demand forecasts
- Optimized picking
- Capacity planning

Cloud Technologies
- Mobile access to SC data
- Cloud-based tracking
- Platform integration

Blockchain
- Elimination of errors
- Elimination of delays
- Real-time access to transactions and tracking
- Accountability

Augmented Reality/virtual reality
- Real-time updates/checking
- Language translation
- Anytime, anywhere virtualization
- Freight/loading/pick by vision
- Real-time traffic support

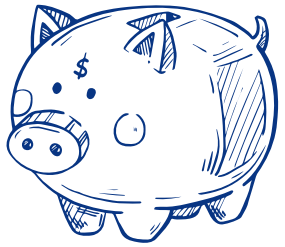
Artificial intelligence
- Self-service processes for suppliers
- Supply chain decision making
- Autonomous vehicles
- New data insights through NLP

Transformation of product design

Design decisions have a huge impact on the TCOG, not only over the upstream part of the supply chain, but also over the product's entire life. The digitalization of supply chains provides an avenue for companies to gather valuable data about the various cost exposures for products, and to adapt their designs accordingly.

Companies typically factor in a product's marketability and the sheer cost of the components that go into its makeup, but not the supply chain risks. A design-to-cost approach on the other hand adopts a more holistic assessment of costs, factoring in risks to the supply chain such as vendor shortages, weather, supply inelasticity, unexpected variances in cost of components etc.

Specialized product cost management platforms can help companies match the correct vendor to supply the parts, as well as help identify savings by estimating what the parts should cost, based on industry quotes. There are companies with thousands of suppliers, where clearly automated solutions would already be in place, but because they are disparate, are yet to fully exploit the advantages of big data and predictive analytics.



Optimizing freight costs through data analytics

Over time, the structured and unstructured data collected and digitized, can provide insights into many areas of the TCOG, in particular freight costs. Data on current and historical freight rates, including quotes from competitive carriers, coupled with routes, through analytics can help companies optimize costs. Companies will be able to automatically benchmark their prices against aggregated market indices. It has been estimated that as much 50 percent of trucks travel empty on return trips. Yet industry surveys reveal that only a minority of companies utilize software or transport management systems to optimize their routes.

Comparative analysis of the costs incurred at various sourcing locations at a profit loss level, facility level, product level and transport mode level can yield valuable insights on the optimal choices in raw material sourcing. One value of internal benchmarking over external benchmarking is that it is easier to make an apples-to-apples comparison. In external benchmarking efforts, certain costs may be hidden

A lot of factors, many unforeseen, can affect freight rates – fuel costs, geopolitical risks, supply and demand for freight, customs clearances, port congestions, the weather, accuracy of documentation, currency movements etc. For companies to be able to make accurate balance sheet projections, they need to be able to make profit and loss forecasts with a fair amount of accuracy. Predictive analytics, though not an exact science because its forward looking, can greatly improve the accuracy of forecasts.

The data opportunity

A systematic data-driven approach to analyzing freight costs

Collate all relevant data

Digitalization brings you one step closer to collating data contained in silos, whether they are to be found in the cloud, in SQL databases, spreadsheets, or emerging from IoT. With sensors and tracking, there will be a wealth of data available to help you uncover freight costs-related insights.

Map your data

Map your entire supply chain, in terms of the various locations, volumes handled, routes etc.

Identify specific problems

- High level aggregated freight spends
- Examples of lane-based inefficiencies
- Data fragmentation
- Level (lack) of data centralization
- Resource inadequacies
- Inconsistencies in plant-by-plant variances

Gain actionable Insights

With big data, the amount of data available will be colossal. But here is where you need to be discriminatory. Data that does not contribute to action is useless. Seek actionable data, standardize them, and present them in a meaningful manner.

Perform analytics

Software-enabled analytics is a highly evolved science today. You can carry out diagnostic, predictive, and prescriptive analyses. Use it to spot trends and identify opportunities.

Diagnostic analytics

- Capture regional spend at a more detailed level
- Establish links to data
- Review spend data according to functions

Predictive analytics

- Lane level forecasting
- Analyze freight cost per part comparisons (plan vs actual)
- Decision support dashboards for analysts and leadership

Prescriptive analytics

- Multi-tier freight analysis: infinite rollup and drill down capabilities
- Decisions on factory/sourcing location
- Freight cost optimization strategies

Share your data and findings

Help create a data driven culture within your organization. Share your data and findings with colleagues involved in the entire supply chain process. Beyond the insights you derive, others will be able to add on, contributing to further optimizations across the supply chain.

Human factors in computing supply chain risks

Automation and robotics are forcing societies to ask some hard questions about the value of humans in the workforce. In the coming decade, according to one United Nations Study[1], millions of low-skilled jobs look set to be replaced by robotics around the world. Apple supplier Foxconn's replacement of 60,000 workers with robots was a harbinger of things to come.

The supply chain process includes numerous documents and data entry. Human beings can overlook important details or make mistakes when doing data entry, contributing to delays and inefficiencies, sometimes incurring fines for under-declarations or mis-declarations at customs. Analytics performed on erroneous or incomplete data, can lead to flawed conclusions and decisions.

Management can either rely on a subjective, experience-based approach by various individuals to assessing the severity of risks, or use a more scientific, data-based approach, where the impact of risks tracked over a period of time. Consider – a person who has been in a role for three months will have different assessments of a situation from a person who has been there for three years. Machines don't have similar biases.

The other benefit of digitalizing data is that it can then be consolidated across silos and subsequently shared across the enterprise as well. Decisions based on data aggregated over the entire enterprise rather than from individual silos will obviously be sounder. A case can also be made that a data-driven enterprise will be more collaborative across departments, as there will be less subjectivity and disagreements over data.

[1] http://www.ilo.org/public/english/dialogue/actemp/downloads/publications/2016/asean_in_transf_2016_r2_future.pdf

Creating a culture for visibility

Many organizations regard the creation of a transparent supply chain as a largely technological challenge. By making this assumption, what they essentially do is overlook the "humanness" of current supply chain processes and relationships, reducing the discussion to a matter of obtaining the right software. The problem with this approach is that supply chain processes and relationships vary from company to company and any cookie-cutter software will be ill-equipped to abruptly replace human beings. Transformation of supply chain processes need to be evolutionary rather than revolutionary and for this to happen, organizations need to acknowledge and respect the criticality and centricity of humans.

While global supply chains are inherently complex, technology and, in particular, data analytics, have the greatest contribution to make, especially when the supply chains operate in silos. There is considerable resistance to change and perhaps the answer is not to try and replace existing processes but to add an additional layer of technology to facilitate data collation and big data analytics.

The human factor is indispensable to some of the common requirements in supply chain processes – i.e. screening through 3PLs/suppliers, instituting KPIs/metrics for evaluating them etc. However, it is important to recognize that organizations composed of value-adding individuals will be more empowered to make the right decisions if they are based on a data driven approach.

The other challenge with incorporating technology into supply chains is that for that to be effective, it needs to be truly end- to- end,- integrated across the entire supply chain, which means all the systems in place across a company's suppliers and partners need to be able to talk to each other seamlessly. To date, given the myriad of systems, the lack of standardization, as well as the immaturity of the technology enablers in this area, a truly integrated, end-to-end, data-driven supply chain infrastructure has been a pipe dream. However, this is likely to change, as cloud technologies, IoT, and big data are increasingly incorporated into supply chains - it's a matter of when and not if.

Gaining visibility, introducing technology – the roadmap

A recommended process for gaining supply chain visibility and introducing technology:

Engage and understand the needs of all stakeholders

The entire supply chain process involves people, who face varying challenges on a daily basis. Therefore, the first step in gaining end-to-end supply chain visibility should be to engage them, to understand their priorities as well as how things work in their respective domains. This domain knowledge would be critical to applying technology in a sensible fashion. Critical questions you will need to answer include: How does information flow across the supply chain currently? What is the kind of data you need to improve processes? What format do you need this data in?

Identify goals/find alignment and common objectives

This is a very important step. Achieving supply chain optimization requires achieving stakeholder support, and the most effective way to do this is by paying attention to the 'what's in it for them'. This is the stage at which you identify commonalities in objectives. While priorities may vary, you should be focused on building alignment across functions, all with the ultimate aim of implementing technology to achieve greater visibility, and thereby reduce the TCOG.

Explore synergies, build bridges

As you go through the process of learning and understanding about your partners in the supply chain, be on the lookout for opportunities to simplify workflows and eliminate bottlenecks. In addition, identify the information silos, across your partner/supplier network, as well as within your own company. Explore ways to build bridges, for better information flow and to facilitate streamlined processes.

Develop a long-term strategy, with data at its centre

As data is a central objective of your technology implementation, your strategy should be centred on it. Your strategy paper should include the objectives and guidelines behind data sharing. By providing clarity on the objectives of the processes you are to recommend, you will be helping to build trust across your suppliers, partners and 3PLs – critical for effective collaboration and data sharing.

Improve processes, introduce technology

Having earned the trust of people across your supply chain organization it is then time to implement the necessary changes and to start evaluating the feasibility of introducing relevant technologies, including shared visibility platforms. Your partners may already have platforms in place – see if any software you are evaluating can sync with existing investments. Remember, change does not need to be revolutionary. Sometimes, you may achieve success through a gradual process of influencing your partners.

Technological and data challenges

Data quality

You can implement the best systems, but if the quality of your data is dubious, in terms of relevancy, accuracy, and extent of it, it can end up skewing conclusions. Having a balance of data is also important – data collected should be weighted according to their relative importance. Many organizations currently may not be prioritizing freight cost optimization because the data is not collected comprehensively and/or accurately. And do remember the old adage – garbage in, garbage out – the quality of your decisions will hinge on the quality of your data.

Internal resources

Companies may simply not have the resources to implement a truly data-driven supply chain, with processes in place for data entry. Companies can outsource the data collation to 3PL partners, some of whom have started providing such services.

Supply chain complexity

A number of factors can increase supply chain complexity, complicating the problem of data collation – i.e. number of partners, number of components, geographical distribution of supply chain, complexity of product design etc. In addition, as long as 'dark objects' (– objects not embedded with any sensor or tracking technologies) – exist, there will be missing information that cannot be factored in.

Platform variations

As earlier highlighted, platforms across the supply chain process vary greatly and are often implemented for specific purposes. Lack of standardization is a major problem in data analytics. However, cloud computing and standardized protocols for data exchange are alleviating this problem to some extent. Even then, the formats in which the software platforms may provide the data may vary across your supply chain.

Achieving supply chain visibility to data - *Choosing a software platform*

Any software that you implement needs to be able to receive data from multiple platforms and standardize them in way that is meaningful to supply chain executives. Management may wish to review the data collated in multiple formats - maps, charts, tables etc. – some platforms may offer more flexibility in terms of data visualization, and obviously that's a benefit. In addition, a platform that can be programmed to push data proactively could provide users with automated alerts for key events and process irregularities.

CASE STUDY

BMW's Connected Logistics Supply Chain

BMW is thinking far ahead. The company has outlined a vision where data relating to the entire supply chain will be fully visible, through the digital cloud. Sensors embedded in parts, containers or trucks will transmit information in real time on inventory levels, their locations, as well as conditions. Even external factors as the weather, strikes, and border closures, will be factored in, with contingency rerouting of freights, or backup transportations to mitigate the risks. The data continually collected will be used to further improve routes.

While the company's vision for a truly connected supply chain is still some years away, BMW has been making incremental steps forward. Recent steps include new types of material handling equipment, improvements to transport visibility and even green transport. While individually an enhancement in each area may contribute to a small productivity gain, collectively, they can amount to significant cost savings.

Evolution, not revolution

While the potential for emerging technologies to revolutionize supply chain processes is certainly there, based on our interviews and industry surveys, the majority are not seizing these opportunities just yet. Supply chain executives need to look beyond meeting goals on a quarter-to-quarter basis and adopt a more strategic longer-term view of mitigating risks to the supply chain, and optimizing costs. While radical overhauls to current processes and technologies may be difficult to push through, a longer-term perspective may encourage gradual change.

The companies with the most complex supply chains will be the ones to benefit from digitization and big data analytics. Yet this complexity itself can dissuade change. Only few companies have appointed a Chief Supply Chain Manager in their executive team; someone whom can be instrumental in linking the entire organization and lead the way to much needed change. Radical overhauls to existing processes also carry risks – and many organizations are just not prepared to stomach the costs of any supply chain disruption resulting from downtimes incurred during this change phase. Again, what is really needed is a longer-term perspective of the strategic benefits, one that ultimately reduces the risks of supply chain disruptions. A little risk taking may be well warranted. As pointed out in Chapter 1, 65 percent of company executives reported that they experienced at least one incident that caused a significant supply chain disruption in the preceding 12 months[2]. And new threats such as cyber risks and terrorism are emerging as well.

From a cost-benefit analysis, the imperative for change is certainly there. If risk of supply chain disruptions is too daunting to management, then incremental change is definitely a viable option, as the enabling systems, technologies and standards continue to advance.

[2] BCI Supply Chain Resilience report 2017; https://www.thebci.org/uploads/assets/uploaded/23750e80-0bc1-4a8b-8c6c52241a468155.pdf

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