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Chain Challenges

Gathering supplier data up front reduces risks

by David Collins and Renaud Anjoran

In 50 Words Or Less

- The more complex and longer a supply chain is, the higher the risks for quality issues and delays to emerge.
- Knowing a supply chain from front to back helps an organization better understand possible risks.
- Evaluate each supplier and subsupplier to reduce risks.

THE MAJORITY OF American and European companies that manufacture products overseas (particularly in China) have no idea what their supply chains look like or even how many suppliers and subsuppliers make up the complete supply chain.[1] For those who contract with suppliers—the buyers—this lack of visibility can create challenges, whether they're quality issues or unexplained delays.

Toyota decided it needed to know precisely where its suppliers were getting their parts after the tsunami in Japan disrupted its supply chain in 2011. Only after Toyota determined all of its subsuppliers' locations was it able to implement its disaster recovery plan.[2]

Two main factors can influence risks in a supply chain:

1. **Complexity**—Are there many steps (suppliers and subsuppliers) involved in getting a finished product to you? The greater the number of subsuppliers involved, the greater the complexity and, consequently, the more risk.
2. **Distance**—Do product parts come from another country or across the world? Many parts for autos or other manufactured products come to the United States from Asia or Europe. Parts can be on a ship for weeks and must pass through customs. Then they may need to be transported to a subsupplier of yours in your country—either by train or truck—and transported again before arriving at the buyer's company.

As illustrated in Figure 1, buyers face greater risks and less control when their supply chains involve multiple levels of subsuppliers and sub-subsuppliers.

Unfortunately, knowing all the parts of your supply chain might be difficult, if not impossible. Two common challenges for buyers include:

1. **Subsuppliers' identities are concealed**—This often happens when a supplier wants to maintain control. Either the buyer directs where the components must be purchased or the supplier handles the sourcing. In the latter case, suppliers often conceal subsuppliers' identities. Figure 2 illustrates the importance of a transparent supply chain.
2. **Undisclosed subcontracting**—A buyer may approve a manufacturing facility, but production could take place at another plant without the buyer's knowledge. Walmart adopted a zero-tolerance policy regarding this type of subcontracting in 2012 after 112 workers died in a fire at a Bangladesh garment factory that was producing Walmart's Faded Glory brand of apparel.[3]

Four types of risks

The more complex a supply chain and the greater the distance between buyers and suppliers, the greater the risks can be in the following areas:

A quality issue isn't detected at the factory of origin. The part comes to a buyer, and the buyer uncovers the issue when it performs the final product diagnosis. The issue is only identified at the buyer's warehouse because no tests or inspections were done during any of the previous supply chain steps.

Now there's a major problem because the buyer's stock on hand must be reworked—or replaced if reworking is unrealistic. Lead time to rework or replace stock could affect delivery to the buyer's customer, which may have a detrimental effect on the buyer's business. There is also a chance of bad products escaping to the customer.

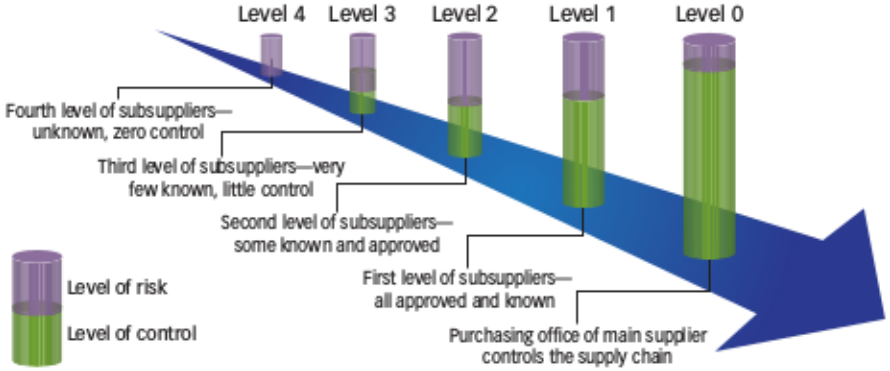
The buyer's supplier has many subsuppliers. With a supply chain comprised of many subsuppliers, there's probably one considered the weakest link. Inevitably, there will be problems that stem from that supplier. The more suppliers and subsuppliers in the chain, the more difficult it is to manage and ensure each can meet the buyer's requirements. Remember, each supplier's quality and cost are ultimately the buyer's quality and cost. In a sense, the entire supply chain belongs to the finished goods company.

The buyer works on a just-in-time (JIT) basis, and there is disruption anywhere in a supply chain. If this is the case, there's little room for error when it comes to scheduling and the delivery of parts. If there's a disruption anywhere along a supply chain, it might result in a break that has an unintended effect on the delivery of products.

The cause of many of these disruptions may be machine breakdowns at the subsuppliers' locations, shipping issues, incorrect paperwork or identified quality issues with unidentified root causes that cannot be fixed in time.

Engineering change is needed. Let's say there is a design change. The buyer must apply its engineering change request procedure for upcoming production, but what about the inventory of

A supply chain's complexity / FIGURE 1



product based on the old design? There may be two or three months' worth of products at different points in a supply chain—stored in warehouses or in transit on a boat, for example. These products might have to be reworked or scrapped, which may lead to delays and high costs.

Impact on cost at various stages

Being able to identify problems in a supply chain and fix them as early as possible is an obvious objective. All too often, however, this doesn't happen.

There is a simple rule of thumb known as the factor of 10, which can estimate the cost impact through a supply chain—depending on when problems are identified (see Figure 3).

The following are examples in which an order for $1,000 worth of finished goods must be manufactured and shipped to a customer, and how the possible costs associated with addressing the problems in a supply chain can be calculated:

Factor 0.1—The problem is identified and fixed during minor-part production. If a minor part of the buyer's product is subcontracted to subsuppliers, identifying and fixing any problems at this stage would affect the cost by a factor of 0.1. The cost of fixing the issue while the parts are still at this subsupplier would have a value of $1,000*0.1 = $100 for a total of $1,100.

Factor 0.5—The problem is identified and fixed during major-part production. Major parts being manufactured for the buyer's product would, by nature, incur more cost to produce. While issues are being identified during manufacturing, the cost factor to rectify these issues would be 0.5. Using the same example with the order value at $1,000, the cost impact would be $1,000*0.5 = $500, for a total of $1,500.

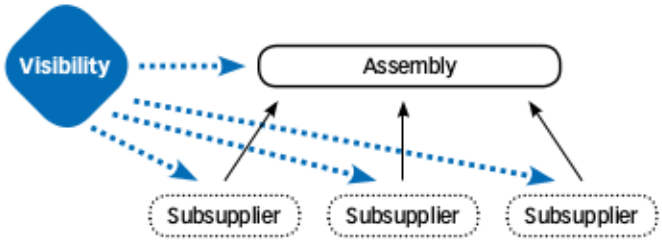
Factor 1.0—The problem is found before a supplier ships major parts. In this scenario, problems are identified after all parts were produced, but before they were shipped from the subsupplier's factory.

The consequence is that the entire process would need to start from the beginning—from raw materials on through packaging. This production would need to be expedited at a high cost. Other orders would need to be suddenly put on hold. The cost factor at this stage would be a factor of 1.0. Using the same example, the cost impact would be $1,000*1.0 = $1,000 for a total of $2,000.

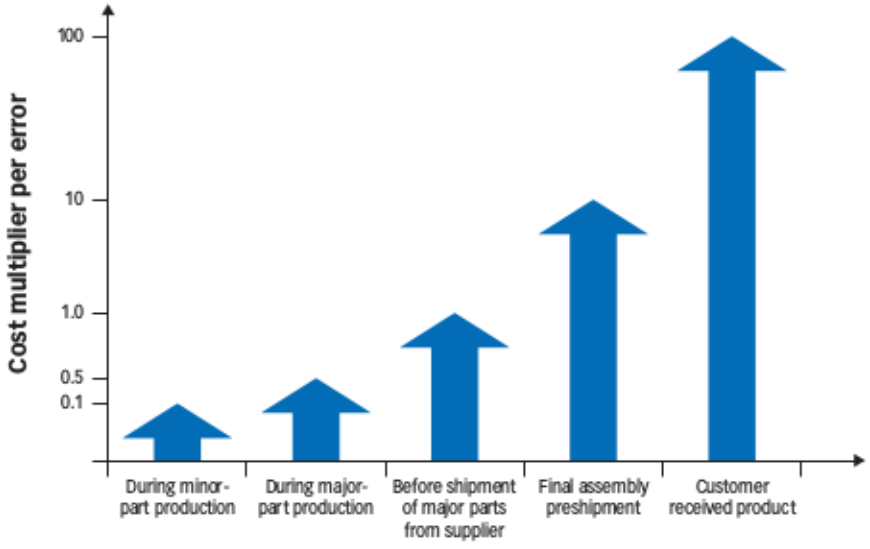
Factor 10—The problem is found at final assembly and before shipping to the customer. All parts have been completed and sent to the final assembly plant, and the product has been assembled and tested. During this final test, a problem is identified that results in products being unfit or being potentially unsafe.

Identifying problems and issues at this stage of the production process could result in a major strip-down and rework of finished products. In some cases, the replacement of major or key components would need to be made.

Visibility over suppliers / FIGURE 2



Cost impact through supply chain / FIGURE 3



Note: The cost factors of 0.1, 0.5, 1.0, 10 and 100 were not derived from a systematic study. Instead, they were in line with what other studies have shown in material goods production and in software development. They also correspond to the authors' experience in material goods production. See Steve McConnell, *Code Complete*, second edition, Microsoft Press, 2004, p. 29, which covers the 1:10:100 ratio in software.

These rework actions at the buyer's final assembly plant may be expensive. The need for replacement parts could mean reordering parts and rushing these orders through, and possibly quickly ordering parts from a supplier far from the buyer's final assembly plant to minimize delays already incurred.

All these issues add up, which explains why the cost impact of a factor of 10 is applied. With the same $1,000 value, the impact is a huge $1,000*10 = $10,000, plus the initial $1,000, for a total of $11,000.

Factor 100—Problems are identified after the product has been shipped to the customer. At this stage of the process, problems identified after the customer has received products could result in recalls, major warranty claims and lawsuits. It's easy to see why the cost impact factor is 100 at this stage. The result would be a staggering $100,000 based on that initial $1,000 value: $1,000*100 = $100,000, plus the initial $1,000, for a total of $101,000.

Obviously, the factor of 10 is only a general guideline and not applicable to every situation. Actual numbers could be quite different, but the concept paints a true picture: In terms of time and money, the cost to fix problems increases exponentially the longer it takes to identify them.

Reducing risk in a supply chain

There are many ways to reduce risk in a supply chain, including:

Using a proven approval process. A process, such as the production part approval process, can be used to verify whether a component supplier has developed its own design and production process to meet its clients' requirements. This procedure aims to ensure the supplier is robust and capable.

Diving deep into your suppliers. Not only is it important to know the identity of each subsupplier in a supply chain, but it's also critical to understand each one's capabilities. Subsuppliers unable to meet the quality standards you require will usually cause problems that lead to delays and additional costs.

Using lean and statistical process control (SPC). It's helpful if each member of a supply chain understands lean and SPC. With lean and SPC in place, you're more likely to avoid most issues altogether and get the remaining issues resolved.

Risk analysis for each component or process / TABLE 1

Component/ process	Likelihood of issues (a)	Time/effort for fixing issues (b)	Resistance to improvements? (c)	Time/effort to switch to new source (d)	Score (a*b*c*d)	High-budget item?	Appropriate actions
Assembly and packaging	2	2	2	10	**80**	Yes	Random inspection on delivery in assembly factory plus regular meetings in factory.
Casing and machining	4	6	4	4	**384**	Yes	Random inspection on delivery in assembly factory.
Painting of casing	10	8	4	8	**2,560**	No	Monitoring of production setup and then reassessing. Work with subsupplier to improve processes.
Rubber feet	2	6	10	4	**480**	No	Random inspection on delivery in assembly factory.

Likelihood of issues: Scored after collecting information about each subsupplier (process audits when possible). Not only the quality issues should be considered, but also long delays due to poor planning or to an automated piece of equipment that is not well maintained.

Time/effort for fixing issues: Review each issue and score the time and effort it will take to fix the issue based on past experience. Look at the process of generating corrective action reports and the ability to fully implement the countermeasures.

Time/effort to switch to new source: One option is to switch production to an alternative supplier. When reviewing this, you must base the risk of moving on the amount of customization, tooling and other special requirements that make single sourcing riskier.

Resistance to improvements: Working with suppliers to improve their processes or systems is a great way of improving quality and delivery of your parts, however some suppliers may be more resistant to these improvements. This type of resistance might come from several factors. You might be one of their small customers. Or managers might not be open-minded to changes. The supplier's attitude will influence the type of monitoring to implement. It might include switching efforts from process improvement to end-of-line inspection.

High-budget item: Spending more to secure the supply of a high-budget component makes more sense because the cost of errors and failure at this level is very high.

Appropriate actions: Ensure the appropriate actions are in place and are carried out. The whole idea of the risk assessment is to reduce risk. If actions are not carried out, the entire process is worthless. It also is important that the risk analysis document be a live and fluid one that is monitored and updated regularly. This could be as frequent as weekly in the beginning.

Building contingencies into your planning system. This may seem obvious, but it's not always that easy to do. Planning for something you can't forecast can be daunting. As noted earlier, some of the biggest disruptions to product supply in Japan have been caused by natural disasters. If you can plan for any type of break in a supply chain, you will be able to minimize downtime or disruption of product delivery to customers.

Protecting your single-source suppliers. In many product designs, there will be one or two unique parts that come from a single supplier. These single-source suppliers must be monitored and managed closely. It's good practice for the buyer's engineers and process specialists to visit these single-source suppliers often to stay familiar with what's happening at their facilities. It also helps to work with them on improving systems and key performance indicators if needed.

Treating suppliers as partners. A buyer must work with suppliers as if they are part of the buyer's solutions. In other words, make the suppliers understand that they play a key role in the buyer's business, and they're actually an extension of the buyer's organization. Give more business to those suppliers that are receptive to suggestions on improvements or required changes, and those that demonstrate flexibility by being accommodating to changes in production schedules.

Communicating real-time data. If possible, the buyer's enterprise resource planning system should be connected to its suppliers so everyone in the supply chain and quality departments can access real-time data. This allows a buyer to make decisions based on the latest information.

Likelihood table / TABLE 2

The table describes the scoring system for measuring the likelihood of the risk occurring and provides a score for each level of risk.

Title	Score	Description
Very low	2	Highly unlikely to occur, but still must be monitored because circumstances could result in this risk becoming more likely to occur during the project.
Low	4	Unlikely to occur based on current information because the circumstances likely to trigger the risk are unlikely to occur.
Medium	6	Likely to occur because it is clear that the risk will probably happen.
High	8	Very likely to occur based on the circumstances of the project.
Very high	10	Highly likely to occur because the circumstances that will cause this risk to happen are also very likely to be created.

Case study: supply chain missteps

Acme Crown (the name has been changed for reasons of confidentiality), a hardware start-up based in the United States, was experiencing delays and problems with a product launch. The company faced huge sales losses because of delays caused, in part, by some subsuppliers.

The company had developed a new electronic product, which it funded and presold successfully via Kickstarter. While independently sourcing a few critical components from suppliers located in China, Acme Crown also compared several original equipment manufacturers in China for the printed circuit board assembly, final assembly, testing and packaging operations.

The final selection of the supplier, referred to as Jade Dragon, was based on several factors. Most importantly, however, the supplier had a great history of working with two well-known brand-name companies, and it was willing to disclose the names of all of its subsuppliers.

After being selected by Acme Crown, Jade Dragon designated one production line for the new product and provided Acme Crown with some dedicated staff members, such as a new product introduction manager and test engineer.

When full production orders were placed, it quickly became clear that the first production batch would be late. The lack of a holistic planning approach for the launch and an inability to hold component suppliers accountable to their commitments became key problems.

The production launch of Acme Crown's product involved mechanical, software and electronic elements. Jade Dragon was overenthusiastic throughout the product development discussion and had promised to meet tight deadlines up front, but the supplier was unable to assemble even small batches as part of the prelaunch process.

While sourcing certain mission-critical components directly, Acme Crown relied on Jade Dragon to identify and select subsuppliers for the more-common components. Unfortunately, the subsuppliers had not been not properly vetted, and several were unable to reach the quality standards Acme Crown required. The parties involved realized these deficiencies only after

orders to these subsuppliers had been placed.

To make matters worse, Jade Dragon failed to inspect components upon delivery. Defective batches of components were detected in the manufacturing of prelaunch small batches, derailing the batch production each time.

At that point, Acme Crown changed its approach and needed to plan the product launch again and review Jade Dragon's manufacturing processes. Acme Crown needed to actually work hands-on at some of the subsuppliers' facilities because these subsuppliers could not be easily replaced with more qualified ones.

This additional work ensured the quality and production systems at those facilities would produce acceptable components.

Prioritizing actions

Acme Crown carried out a risk assessment on parts manufactured and process actions throughout its supply chain. The risk assessment allowed it to formulate a priority list similar to a failure mode and effects analysis (see Table 1, p. 18, and Table 2, p. 19).

Acme Crown outlined a list of appropriate actions and implemented each. It hosted regular meetings at Jade Dragon:

- At 6:30 a.m. on Mondays to ensure the weekly production would start on time and to ensure quality workmanship.
- Each Tuesday to review the first day's production and help the factory fix any problems.
- Each Friday to get parts in place for the following week.

Sensitive to the fact that there was no time to replace certain subpar component suppliers, Acme Crown's representatives visited each one on site.

One subsupplier was having problems with the painting process, which resulted in several quality problems. One color had a low yield (under 20%). The process was improved quickly by bringing in technical experts and training subsupplier employees. This helped to address specific problems in the process:

- The proportion of solid in the aluminum sulphate bath was not being kept under control. The manufacturer's employees were taught how to properly check the tanks for each chemical composition.
- The sanding was done with large-grit sandpaper. A finer sandpaper was put into use.
- Operators were touching parts without gloves. Several measures were implemented to eliminate potential sources of contamination.
- The air dryer was improperly configured (the temperature was not low enough).

By implementing prioritized and targeted actions, Acme Crown was able to contain the production delay and reach its quality requirements.

Identifying and evaluating all the subsuppliers involved in building components and providing services that went into the production of Acme Crown's final product were essential steps to reach its objectives.

Up-front investment

Granted, it can take a great deal of time and effort to learn about your suppliers and subsuppliers, and understand their abilities up front before committing to them. Buyers should not take anything for granted nor assume anything about suppliers. Ultimately, suppliers become extensions of the buyers and, as we've seen, this can turn costly.

The time buyers spend learning about suppliers is certainly not wasted. Consider it an investment in the buyers' business. Ideally, if buyers can prevent any problems with suppliers and subsuppliers that could lead to rework and recalls, or even damage its reputation, the up-front work is time—and money—well spent. QP

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