# Supply Chain Interoperability Efforts Missing Key Data

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**Abstract.** True manufacturing supply chain interoperability—where the assembly, reconfiguration and reconstitution of supply chains are done with minimal effort, time or cost—can dramatically alter the way that business is done today. Much of the existing research on supply chain interoperability focuses on established trading partners. However, we must consider both the sourcing and connecting processes in order to create true, dynamic supplier networks that can be easily assembled, reconfigured or reconstituted. This paper identifies why this is important, presents key challenges and proposes additional research that is needed to fill in the gaps.

**Keywords:** Supply chain, supplier networks, interoperability, manufacturing.

## 1 Introduction

Manufacturing supply chain interoperability efforts are missing key data that must be addressed if manufacturers are to achieve the vision of fluid, dynamic supplier networks. Much of the existing research focuses on supply chain interoperability between established supply chain participants. In many cases, the supply chain is considered to be "interoperable" if the participants are connected at the data, service, process and business levels. (Veronica Pazos Corella, 2013) (Ray & Jones)

What happens when new supplier networks need to be assembled, or when new participants must be added to existing supplier networks to increase capacity or replace a lost supplier? How does someone first locate a manufacturer with the right capabilities and capacity at the right time? How do they then know that the new participant's systems and processes will fit with those of the existing supplier network participants? Finally, what effort will be required to "onboard" the new supplier—that is, to connect the supplier's data, services, processes and businesses?

The missing data is how to efficiently source and seamlessly connect to new trading partners. It is this capability that helps manufacturers move from their reliance on static supply chains of existing partners to dynamic supplier networks, which can easily be assembled, reconfigured or reconstituted. The following definition, which is a variation on other commonly used definitions, is proposed to support that approach.

> "Supplier network interoperability is the property of an organization, whose capabilities and interfaces are completely understood, to work with other organizations, present or future, without any restricted access or additional implementation."

V. Prabhu, M. Taisch, and D. Kiritsis (Eds.): APMS 2013, Part I, IFIP AICT 414, pp. 318–324, 2013.

Unfortunately, there is little research to fully flesh out this challenge, particularly for the unique demands of complex manufacturing supply chains. This paper identifies the various issues and the work that is needed to advance efforts in this area.

## 2 Motivation

The benefits of addressing and solving these challenges can yield significant value to both buyers and suppliers of manufactured goods. Challenges ranging from increased personalization to demand fluctuation and sourcing closer to the point of consumption can't be met easily with today's inflexible supply chains. Supply chain risk mitigation strategies also are limited today and could change dramatically if the time and effort to add or substitute suppliers were slashed.

In short, achieving a "plug and play" supplier network—where new supplier networks can be assembled and new participants added or substituted at very little cost and with minimal time or effort—would change everything. Examples of specific benefits include:

- More quickly field new products;
- Readily secure capacity closer to the point of demand;
- Easily add capacity to meet demand fluctuations; and
- Recover immediately from supply chain disruptions.

## 3 Manufacturing Supply Chain Interoperability Challenges

The process of sourcing (locate, evaluate, query, qualify, negotiate and contract) and connecting (data, services, processes and businesses) new trading partners is costly and time-consuming. Many companies simply work with the same base of suppliers over and over again to avoid these issues. In addition to limiting supply chain flexibility, this approach also limits the ability to apply pricing pressure and stifles innovation. Following are some of the specific challenges for various steps in sourcing and connecting manufacturing supply chains.

### 3.1 Sourcing a Manufacturer (Locate, Evaluate)

This challenge is compounded by the fact that there are a number of considerations to even begin choosing a manufacturer. For instance, standard questions determine if potential suppliers have:

- The tools and experience to work with the specified materials;
- Equipment to handle the size and tolerances required; and
- Skill sets and certifications to help ensure quality and delivery.

Beyond the basic requirements, buyers today are looking for increasingly sophisticated information to help them make sound sourcing decisions:

- Are supplier facilities close to the desired point of manufacture, distribution or consumption?
- Does the supplier have sustainable practices?
- How well does the supplier collaborate and innovate?

Identifying and quantifying some of these considerations just to help locate and evaluate firms to be included in sourcing efforts can be very difficult. First, there is the mismatch between the description of a buyer's need and a manufacturer's capability. There then are the challenges of disparate formats and terminologies, often describing the exact same process or capability.

### 3.2 Sourcing a Manufacturer (Query)

Once a target list of manufacturers is identified, prospective suppliers must be queried to gather key information. This query is typically a sourcing event, such as a request for quote (RFQ) or request for proposal (RFP). In the past, the buyer was often focused on price, quality and delivery. However, buyers today increasingly are seeking information that has no standard definition and is not included in common electronic data interchange (EDI) or Extensible Markup Language (XML) schema. For example, specific technical capabilities, information on sustainable practices and innovation experience are becoming increasingly important when selecting manufacturers.

There are a number of challenges to effectively sourcing manufacturers. The first is just sending an RFQ that all recipients can open, interpret and respond to in a consistent manner. While that would seem simple with today's technology, there is still considerable effort involved. Each buyer's RFQ format is different and quite often requires clarification and augmentation before a supplier can provide a quote. (In fact, many manufacturers still send RFQs and technical data via fax, mail and email.) The second challenge is clearing the hurdles around technical data, which can include formatting, intellectual property control and translations.

### 3.3 Sourcing a Manufacturer (Qualifying)

A major hurdle in working with a new manufacturer is the qualification process. This challenge is particularly important to industries with complex products, such as aerospace, defense, automotive, medical equipment and others. One of the most typical, but least efficient, qualification means is to conduct an onsite visit to gather information about past performance and document processes, skill sets and equipment capabilities. While this qualification process often is crucial to help ensure the supply chain delivers quality goods on time, the process inhibits exploration of new partners.

Some work has been done to identify how an "interoperability potentiality measure" could help determine the level of effort required to work with a new partner. (Chen, Vallespir, & Daclin, 2008) However, this approach is still in the nascent stages and primarily focuses on the conventional aspects of interoperability for data, services, processes and business. Product interoperability standards (Will this supplier's product meet my requirements and be delivered on time for the right price?) have not been adequately addressed.

### 3.4 Connecting a Manufacturer

Once each manufacturer is chosen (remember that assembling a supply chain is often a serial process), the effort begins to connect each to enable the "Three C's" of successful supply chains: communication, coordination and collaboration. When you consider that complex supply chains can contain hundreds or thousands of suppliers, this is a daunting task.

Immediately, the supply chain has to begin exchanging data for technical requirements, demand and production to begin aligning processes, such as sales and operations planning or financial reporting. There then is the issue of coordinating task timeframes and responsibilities, and determining what metrics will be used and how they'll be reported.

All of this must be done with data that have different definitions and formats and come from disparate software programs. In fact, a recent study identified that "more than 50% of the information exchanged between business partners travels over fax, email and phone rather than flowing directly between business applications via B2B integration technologies such as EDI and XML." (Gillai & Yu, 2013) Even those companies that use EDI or XML typically require an effort to align definitions and formats.

## 4 Promising Efforts Currently Underway

There are very interesting pockets of innovation that are addressing some of the challenges in assembling and coordinating complex manufacturing supply chains.

### 4.1 OAG – Standard Manufacturing Service Capability Model

A new Open Applications Group (OAG) activity is being initiated to advance computer-interpretable communication of manufacturing information. For the purpose of initial analysis, manufacturing information necessary to enable contract manufacturing and custom parts ordering within the supply chain is investigated. The goal of the activity is to achieve greater automation in processing manufacturing information, which is typically (1) carried in the RFQ and other electronic documents and (2) exposed online by manufacturing suppliers. The manufacturing information may include manufacturing process capability information, manufacturing information processing capability information (software capability), product functions and product design features. (Ivezic, 2012)

### 4.2 NIST – Manufacturing Services Network Models Project

The National Institute of Standards and Technology (NIST) is conducting a project to enable small- to medium-sized enterprises (SMEs) to more readily participate in advanced production networks. Following their discovery and qualification, SMEs need to be able to receive and use digital manufacturing data and effectively respond to the

requests to make the parts. The Manufacturing Services Network Models Project aims to provide cutting-edge semantic model development and an evolution methodology that allows for rigorous development of a semantic-rich standard for representing and communicating manufacturing service capabilities, including material processing and manufacturing information processing capabilities. Project deliverables include reference models, methods and tools to support the manufacturing service capabilities standard development. (Kulvatunyou, Ivezic, Lee, & & Jones, 2012)

### 4.3 KITECH – *i*-Manufacturing

South Korea's KITECH organization has developed a collaborative manufacturing platform that essentially allows its SMEs to plug in once and connect to many, regardless of disparate systems. Started in 2004, this system facilitates supply chain collaboration for more than 1,000 companies across multiple manufacturing supply chains. While its initial focus was on the molding industry, it is quickly expanding into other industries and delivering quantitative benefits that include a 33% reduction in time and a 16% reduction in costs.

## 5 Research That Is Needed

There is plenty of anecdotal evidence to support these challenges. However, there is very little in the way of quantitative evidence to identify just how bad the problem is and help provide direction and priorities for solving the challenges. This is particularly important to help manufacturing supply chains become more globally competitive.

### 5.1 Research Need #1 – Quantify the Process Inefficiencies

The first step should be to quantify the time and effort required to perform the sourcing and connecting tasks today. As the results will vary by industry, manufacturing complexity and other factors, a framework should be developed that would accommodate and capture those differences. This effort must look across all nodes of a supply chain, as there will be differences at the various tiers. Finally, manufacturers must understand the impacts of those inefficiencies, particularly on products and production, and identify how companies currently negate them.

### 5.2 Research Need #2 – Identify Information Flow Details

Streamlining the effort to source and connect new manufacturers requires understanding what information is needed for these tasks and how that information is exchanged today. This is particularly important for the volumes of unstructured data that are required to source and connect to new suppliers. Due to the complexities of manufacturing supply chains, there are numerous issues beyond what is normally contained in EDI or XML schema, such as the exchange and protection of technical data and the collaboration around it.

### 5.3 Research Need #3 – Build the Business Case

Once the "as-is" picture is understood, a case needs to be made for the "to-be" scenarios. Some of the easiest projections will be simple reductions in cost and time. However, the greatest business opportunities won't be as readily obvious or as easily quantified. Some examples of revised thinking include the following:

- Could the need for and trappings of long-term agreements be negated?
- Can pricing and volume be decoupled, making feasible a lot size of one?
- How does complete supply chain flexibility alter product customization?
- What risk mitigation strategies are best if adding new suppliers is frictionless?

## 6 Summary

True manufacturing supplier network interoperability—where the assembly, reconfiguration and reconstitution of supplier networks is done with minimal cost or effort—can dramatically alter the way that business is done today. However, achieving truly dynamic supplier networks requires a considerable amount of work. In fact, the National Coalition for Advanced Manufacturing (NACFAM) wrote about these very issues in "Exploiting E-Manufacturing" in 2001, yet little progress has been made to-date. (National Coalition for Advanced Manufacturing, 2001)

Despite all of today's advanced technology, the assembly and coordination of manufacturing supply chains is still very inefficient. While most people in the manufacturing industry can share many anecdotal tales that illustrate these inefficiencies, the industry does not have solid, quantitative evidence of the impact on products and production. Such evidence would be an eye-opener for many and can help identify where the needs are the greatest.

The really exciting opportunity is to identify how dynamic supplier networks could be assembled and coordinated in the future. If all information is interoperable, will modeling and simulation agents be able to analyze myriad permutations to design a supplier network that yields the best product for the consumer while optimizing production and profits for the suppliers? Will technology facilitate the design and assembly of unique supplier networks for each order? Will we reach a point where suppliers can be added or swapped out of supplier networks with little time, effort or cost?

Building a sound business case for a future vision of dynamic manufacturing supplier networks will provide the industry with a roadmap of what needs to be done to achieve that vision.

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