CASE STUDY IN APPLICATION OF PROJECT SCHEDULING SYSTEM FOR CONSTRUCTION SUPPLY CHAIN MANAGEMENT

Kalyan Vaidyanathan[1]

ABSTRACT

The AEC industry traditionally operates on trust based relationships formed on a project-by-project basis. Inefficiencies in the AEC industry lead to unreliable project due dates, inability to meet project budgets, and low customer satisfaction levels. In some cases, businesses involved in the AEC industry have capitalized on ill-defined information to increase margins.

The paper will discuss these issues in the context of a case study of a large retailer involved in the house reconstruction market. The retailer is attempting to change its business process, manage their supply chain, and manage their orders that have products and services as projects. The paper will describe the difficulties involved in changing the business process and data collection and provide insight into issues involved in implementing the objectives of the retailer.

It can be proven that by a fundamental change in the business process, if all the people involved in the project to openly share information, the inefficiencies in the project can be substantially reduced, if not eliminated. This can lead to on-time intelligent procurement of materials, better on-site coordination of labor and material, an overall increased utilization of labor, and ultimately to reduced project delivery time. But in order to realize this objective, businesses must be willing to share proprietary enterprise data, disparate legacy systems have to be integrated to exchange information in a consistent format, and data essential to the new business model needs to be collected. Finally, the savings realized through such streamlining has to be shared among all parties to be fair.

KEYWORDS

Supply chain, collaboration, communication, retail, data collection, information flow, information sharing, business process re-engineering

[1] Senior Product Manager, i2 Technologies, 5 Cambridge Center, Cambridge MA 02142, 617/551/-2780, FAX 617/761-2974, kalyan@i2.com

INTRODUCTION

The architecture, engineering, and construction (AEC) industry is one of the oldest industries in civilization. For over two hundred years, the industry has operated on the basis on trust-based relationships. The industry is largely separated along trade lines; trade contractors either form teams or work together to complete a project. Typically there is a project superintendent to oversee and coordinate construction of the entire project. For example, in an office or residential building, the architect oversees the work during the design phase of the project. He sub-contracts design work to the structural engineer, HVAC engineer, electrical engineer etc. But, during the construction phase of the project, the GC oversees the work and coordinates work between the various trade contractors. In a house reconstruction project, a project coordinator or sometimes the customer coordinates work between the various trade contractors.

In recent years, several project based collaboration tools have been developed for the AEC industry. But adoption of these tools has been restricted to big projects and among big institutional players; players in small reconstruction projects still collaborate in the traditional way: via phone and fax. In small house reconstruction projects, the problems are different. First, job durations, although small, are difficult to estimate accurately. Second, poor coordination causes the schedule to be extended. Third, rescheduling and scope expansion is typical. All of these make it difficult for downstream contractors to plan their schedule upfront. This causes project schedules to be drawn out longer than necessary. The whole supply chain is fragile. Traditionally, project durations are padded with conservative estimates based on experience to reduce the impact of this variability. All these factors have led to low customer satisfaction levels, high cost associated with variability, and a risk averse trade contractor community.

In an attempt to change all this and improve customer service, a major retailer is undertaking a huge challenge. They are attempting to share information from product vendors and service vendors to increase visibility, better collaborate, and provide future of home remodeling services. Their aim is to provide a more reliable due date for home improvement projects when the customer initiates a project in their store using product shipment information from product vendors and service provider schedule and capacity availability information from contract service vendors. They are modifying the supply chain to act as the orchestrator for the entire collaboration. The following paper will attempt to discuss the retailer's objective and where they are in their charter to create a better customer experience. Their primary objectives are the following:

- Improve customer satisfaction by providing reliable due dates for project completion
- Streamlining their business to have better accountability, auditing, and centralized control of good and information flow
- Reduce project delivery timelines
- Better forecast demand and plan for resource availability

PROBLEM

In their current business, the retailer is involved in selling thousands of home improvement products. Starting from a simple carpet installation to a whole house redesign including kitchen, bath, and flooring remodeling, the retailer historically is in the business of selling products. Selling value added services on top of that has been done through contractual relationships with relevant trade contractors or service vendors. They have existing relationships with contractors that provide measure, deliver, and installation services. But all collaboration is through phone or fax. There are dedicated employees that handle the collaboration in the case of complex projects acting as project superintendents. The current construction supply chain for the retailer is shown in figure 1. The supply chain can be described in the context of a carpet installation. A typical carpet installation has the following process:

- Customer orders carpet and store promises a phone call from measurer to get measurements
- Store calls measurer and gives information about customer
- Measurer calls customer and schedules appointment for measure
- After measure, measurer updates store with information
- Store contacts customer and closes sale, orders product
- Product vendor receives order, provides promise dates
- Product is either received at the store or shipped directly to installer
- If product is received at the store, it is reached to the customer.
- Once product delivery confirmation reaches store, store contacts installer
- Installer contacts customer for install schedule, installs carpet
- Store calls customer to ensure order is done and closes the order

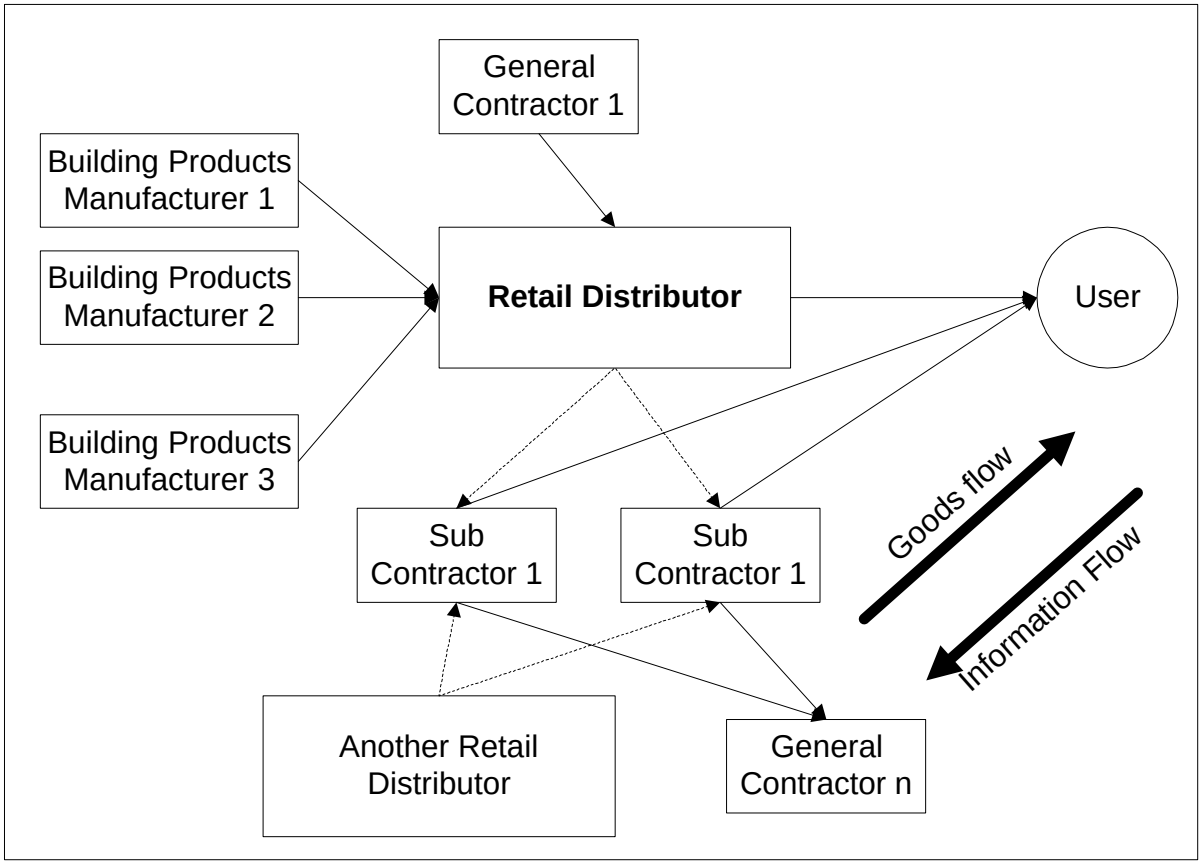

Figure 1: Current supply chain with existing business model

In the figure shown above, coordination of project happens with human intervention. There are very few process controls and no real target deadline to meet for the customer. Somebody has to remember the sequence of steps in the project to keep it on track. The only time the system notifies a human is when a job is delayed. There is no proactive prompting. In the case of complex projects, this approach is error prone, causes rework, and wasted trips for contractors reducing their utilization. All of this has led to the following problems.

- Multiple attempts by contractors to schedule services with customers
- Job charges from vendor to retailer is higher than it has to be to account for wasted resource utilization
- Project due dates are difficult to quote to customer
- Lack of proactive communication with customers and vendors in case of delays, leading to dissatisfied customers and vendors.

From the contractor's point of view, demand fluctuates and capacity planning becomes infeasible. In case of rescheduling, and delays, lax in communication leads to wasted trips for downstream vendors and reduces resource utilization. The contractors perform work not only with the retailer, but also with other retailers in the same business, and other general

contractors. Their capacity is distributed among the different demand sources. The fluctuating demand from various sources exacerbates the situation and this multi-enterprise interaction effect makes proactive capacity planning near useless. With no ability to project their demand service vendors buffer their fluctuations with temporary labor and/or due date slippage, both of which cost higher to complete the job.

SOLUTION

To address these problems, the retailer is looking to overhaul its business process and put a system in place for better project coordination. A look at the construction supply chain indicated that with a small shift in the flow of information, tremendous value could be realized. See figure 2 for modified supply chain. The retailer acts as the central orchestrator of information flow. The proposed solution works as follows:

- Retailer promises dedicated demand to vendors in the form of percentage of all orders from an assigned group of stores
- Vendors sign agreement with retailer to promise dedicated capacity to meet an agreed service level agreement (SLA). This helps isolate the capacity from the influence of the multi-enterprise demand for the vendors.
- Vendors will input and maintain capacity into the retailer's resource planning system
- Project schedule will be computed based on average job durations and standard product lead time
- Individual job scheduling will be done on a schedule forward logic based on available vendor capacity
- Schedules and project execution will be based on a schedule forward basis. Wherein one job has to be completed to trigger the scheduling of the next downstream job.
- Electronic notification will drive communication between jobs, to customer, vendor, and retailer
- Collect better lead time data from product vendors
- Historical data will be built to accurately predict demand for their service vendors and over time help their vendors manage their capacity more effectively.

In the modified supply chain, the carpet workflow gets modified as follows:

- Customer orders product and system gives customer measure schedule date based on measurer capacity
- Measurer does measure and updates order with results
- Store closes sale and places order for product
- Product vendor responds with promise dates

- Product arrival triggers installer notification and scheduling of the install job.
- Installer completes job and that triggers order to be complete

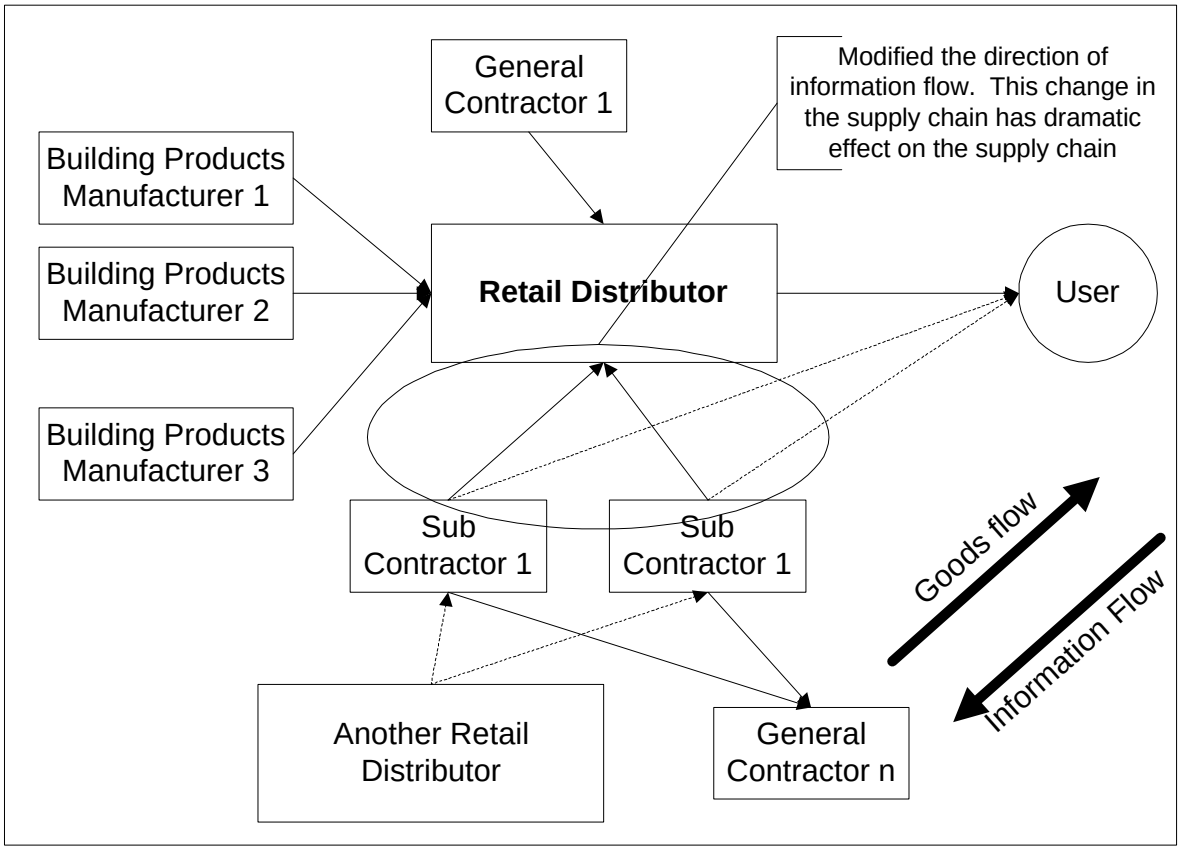

Figure 2: Modified Supply Chain with new business model

By taking control of distribution of information, the retailer is essentially being more accountable to the customer. The bullwhip effect of information lag is reduced. The communication is more streamlined and centralized leading to reduction in project schedules.

DISCUSSION

REDUCED PROJECT DELIVERY TIME

The Table 1 provides a comparison of the expected benefit from the future business process as compared to the current business process.

Table 1 Comparison of the expected benefit from the future business process

	Old Process	**New Process**
Order create to measurer notification	0.6 day	0.1 day
Time to schedule measure	3 days	1 day
Measure done to store notification	1 day	1 day
Store notification to order sold	4 days	4 days
Order sold to product receive	10 days	10 days
Time to schedule install	10 days	1 day
Total	**28.6 days**	**17.1 days (60% reduction)**

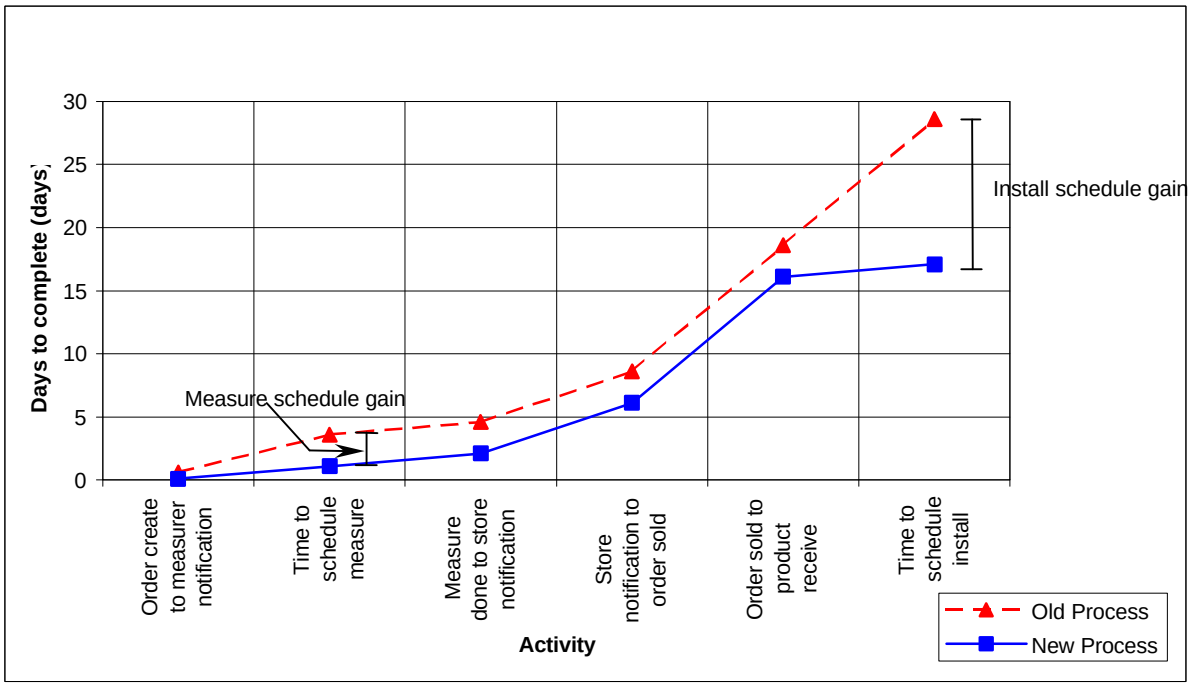

Figure 3: Project Schedule Comparison

If executed, the table above summarizes the effect of the new information flow. In the case of a simple carpet installation, the table above reflects the project duration for the current and modified supply chain. By streamlining this information flow, the expected reduction in project duration is around 50%. From figure 3, the reduction in schedule is primarily due to better collaboration of service providers to schedule jobs. The primary reasons for the squeeze in schedule are the following:

- Elimination of needless back and forth between service vendor and customer trying to coordinate schedules

- No wasted trips for downstream vendors since they get notified only when their job is schedule
- Better resource utilization because vendor time is not wasted in coordinating schedules

VALUE AND ROI

Scheduling jobs in general take 60% less time on a project implies service vendors can do 1.67 more jobs than they can do in a year, if we assume a constant demand profile. And this decrease in time is due to reduction in variability. Assuming the same level of resource utilization, they can increase their revenue by 67%. For the retailer, less time to hold material, and reduced project time implies that they can do more business. They hold material for 50% less than originally used to. Implies they make more money. Costs to customer can be brought down and everybody can win. The retailer and service provider can share the savings and customers can get part of it too. Such a partnering strategy between the retailer and the contractors for mutual benefit will ensure continued success of the new business model.

MODIFIED BUSINESS PROCESS

In the future, the retailer is hoping to move to a business process that will let them schedule the entire project during project creation (schedule all). To achieve that goal, the biggest gap is accurate data. Hence, with the new business process, they are planning to collect history for demand data and product lead-time. They believe that once they can increase the reliability of the data that runs the system, that will give them adequate confidence to more a complete scheduling model. With the current schedule forward business model, the project plan is estimated without the capacity of all service providers needed to complete a project. Once the total system is in place and the data is available to schedule the entire project, the project plan will reflect constrained capacity of all service providers. Planning and execution of such a project plan will be closer to emerging lean techniques (such as the last planner methodology).

RISKS

While there is a lot of value in this simple approach itself, there are still some associated risks.

- Integrity of the solution depends on good data from vendors in terms of accurate lead times for products and capacity from trade contractors
- Service vendor published capacity should match their ability to deliver
- Service vendors have infrastructure problems – no computers and no access to internet
- Coordinating among variety of vendors involves rigor and discipline

- For the whole system to work, it is data driven. Vendors have to continually update their status. In a construction type environment, where being at the site and mobility is critical, mobile access is crucial.

Computing complexity of durations based on attributes is also an unreliable science. For example, the duration of carpet install varies widely depending on whether it is a new carpet installation vs. remove and replace an existing carpet, glue down carpet installation vs. stretch carpet installation, staircase vs. flat floor, existence of furniture etc.

CONCLUSION

The potential value to be realized is huge. The expected value from the system once it goes into production is to be realized in a number of ways.

- For service vendors, payment is aligned with job completion and since system tracks job status to trigger payment, workflow is more streamlined;
- No wasted trips to customer site since system ensures coordination;
- No wasted trips by installer to store to see if product has been arrived;
- Better utilization of resources, higher efficiency for all parties;
- For customers, painless experience, easier to follow status of order/project;
- For retailer, better accountability, more satisfied customers, more business for the retailer.

Changes in supply chain to streamline information flow and managing capacity of contract labor to remove inefficiency requires changes in business process and sharing information across enterprises. Technology is only an enabler. Without adoption and fundamental business process changes, the potential value will never be realized.

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