Research Paper Management

# Advanced Supply Chain Planning (ASCP) – A Study on Construction Companies in Kuwait

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ABSTRACT

*In the last few years, the Construction industry has developed a number of strategies to allow construction companies to enhance their supply chain planning with their supply chain partners, with global optimization. To facilitate this transition in thinking, companies are re-evaluating ways they can use effective supply contracts, various types of strategic partnering, information sharing, and decision support systems. The application of supply-chain management techniques in manufacturing environments has saved hundreds of millions of dollars in production costs while improving customer service. This is because supply-chain management takes a systems view of the production activities of autonomous manufacturing units and seeks to optimize these activities globally. In the construction sector, subcontractors and suppliers are the equivalent of manufacturing units. As subcontractor and supplier production make up the largest portion of project costs, the supply-chain techniques used in manufacturing may deliver similar benefits in construction projects. Supply chain management is a combination of supply chain planning and supply chain execution. This paper critically examines the various advanced supply chain planning (ASCP) techniques used by Construction companies in Kuwait and suggest the level of improvement required for enhancing their performance towards their clients.*

Keywords : Supply Chain Planning, Construction Company, Kuwait

### Introduction

Construction supply-chain management offers new approaches to reduce the cost of and increase their liability and speed of construction. Supply-chain management takes a systems view of the production activities of autonomous production units (subcontractors and suppliers in construction) and seeks global optimization of these activities. Applications of supply-chain management techniques in manufacturing environments have saved hundreds of millions of dollars while improving customer service. Indeed, studies suggest that poor supply-chain planning and design regularly increases project costs by ten percent and may have similar affects on construction project durations. Thus, supply-chain management (SCM) can be expected to reduce the cost of and increase the reliability and speed of construction.

### 2. Rationale

Supply chain planning (SCP) is a component of supply chain management (SCM) involved with predicting future requirements to balance supply and demand. Within most construction organizations, the balancing of its supply against demand is a cross functional effort involving members of various functional entities (i.e. Projects, Procurement, Quality control and Material Control) to minimize mismatches and thus create / capture value.

Supply chain planning is rapidly gaining attention as a key differentiator for companies in an increasingly competitive global environment (Shen, Lee & Van Buskirk, 2001). Koutsoukis et al. (2000) indicate that strategic planning and operational management of supply chains are two leading decision problems in supply chain management. According to Mulani (2001) advanced planning has now gone well beyond the factory and into the supply chain. Enterprises now use integrated planning processes for the sole purpose of building a master plan for procurement and supply.

According to results of a supply chain benchmarking study conducted by The Performance Measurement Group (PMG), well-developed supply chain planning processes are critical to achieving a competitive advantage (Wawszczak, 2003). The study by Wawszczak (2003) shows that companies with mature planning practices are 38% more profitable than average companies, 22% lower levels of inventory and 10% greater delivery performance. The companies that combine mature planning processes with advanced planning systems gain added performance improvements (e.g. including 27% greater profitability).

### 3. Kuwait construction industry

Kuwait's already buoyant economy is the third largest in the Gulf Cooperation Council (GCC) countries, after Saudi Arabia and the United Arab Emirates, with its real gross domestic product (GDP) standing at US$32.92 billion in 2002 (UNESCWA, 2003), which is powered by its 7% of world's proven oil reserves. Oil production and related industries drive the Kuwaiti economy.

As estimated by MEED.com on 29th September 2010 the Value of Construction Projects in GCC stands at US$2.29 trillion. Top 100 projects in GCC region contribute US$ 1.3 trillion and Kuwait contributes more than 35% value of construction activities in GCC. There is a huge scope for efficient supply chain planning and material control methods.

Construction companies in Kuwait, use a variety of supply chain planning initiatives to manage the procurement and material control activities for a diverse range of materials. Project permanent materials, which consist of tagged Items, tagged systems and bulk items such as tanks, heat exchangers, pumps, medium voltage switchgears, chillers, air handling units, fan coil units, generators, cooling towers, control valves, instrumentation items, light fittings, cables, pipes, and so on, constitute more than 50% of the total cost of construction projects. Project temporary materials include minor items such as consumables, tools, safety items, etc required on a day-today basis on a project site.

The Construction Companies in Kuwait are adopting the following supply chain planning (SCP) initiatives to control the Procurement & Material Control activities:

- **Selective Inventory Control -** The ABC analysis is a business term used to define an inventory categorization technique often used in materials management. It is also known as Selective Inventory Control (www.wikipedia.org).
- **Vendor Managed Inventory -** A mechanism where the supplier creates the purchase orders based on the demand information exchanged by the customer. VMI is a backward replenishment model where the supplier does the demand creation and demand fulfillment. In this model, instead of the customer managing his inventory and deciding how much to fulfill and when, the supplier does. (Phani Kumar & Muthu Kumar, 2003).
- **Min-Max Planning –** It is a procedure to determine the size and timing of item replenishment orders and creating a purchase order to replenish stock (www.wikipedia.org).
- **Material Requirement Planning -** Material requirements planning (MRP) is a production planning and inventory control system used to manage manufacturing processes. Most MRP systems are software-based, while it is possible to conduct MRP by hand as well (www.wikipedia.org).

**4. literature review**

Global supply chains are often discussed and analyzed based on two major aspects; the configuration and the coordination of the network. It has been established that vertically focused networks striving for low cost production typically should establish a centralized planning organization (Rudberg, 2004).

Supply chain planning covers the processes of forecasting, capacity management, netting against available inventory and ordering from suppliers where lead times are long. Supply chain execution, on the other hand, is the process of managing material flows through the supply chain in response to real demand or inventory replenishments in the chain (Inger, Braithwaite & Christopher, 1995:251).

According to Shapiro (as referenced by Shen, Lee & Van Buskirk, 2001:69) supply chain planning is the coordination and integration of the activities that happen at manufacturing plants and distribution centres with the purpose of making better supply chain decisions.

Supply chain planning has evolved from Oliver Wight's concept of batch processed time-phased reorder point calculation (i.e., MRP) for stand-alone manufacturing and distribution planning, to a dynamic, integrated synchronization of the enterprise and its trading partners (Peterson, 1999:4). No longer can an enterprise remain competitive by running a weekly distribution and/or manufacturing plan, and then reacting manually to the inevitable exceptions that occur after that point.

Many organizations have focused on optimizing manufacturing scheduling. However, determining the correct supply chain plan can be more important than optimizing an individual plant schedule. Capacity planning is more than just a manufacturing issue and needs to account for demand and distribution requirements as well (Peterson, 1999:6).

The challenge of integrated advanced planning really lies with process integration (Mulani, 2001:27). The concept of time phased planning and the resulting capacity plans enable users to identify future constrains with enough possible time to pursue alternatives (Martin, 2001:62-63). The constraint occurs when their supply chain does not have enough capital, people, equipment, or space to acquire, transport, manufacturer, and/or sell product.

The performance of a supply chain as a whole is to a large extent determined by the way the different planning processes are coordinated and synchronized (Pibernik and Sucky, 2007). Supply chains coordinated on a central basis will lead to better results in terms of, e.g., overall costs, compared to supply chains with decentralized management (Rudberg, 2004; Pibernick and Sucky, 2007). As referenced by Pienaar (2005:81) Ghiani, Laportte & Musmanno indicates that logistics management revolves around planning, organising and executing / controlling logistics processes from strategic, tactics and operational level.

It has been noted that from the above detailed literature review that most of the advanced supply chain practices focuses on merchandising and manufacturing environments and not much work has been carried out on the Advanced Supply Chain practices of a construction companies specially in Kuwait.

**5. Objective**

The objective of this study is to assess the effectiveness of ASCP among the construction companies in Kuwait. In addition to assess the existing Advance Supply Chain an initiative, this study is also suggests areas of improvement required in the existing supply chain planning methodologies.

**6. Scope and limitations**

The study mainly focuses on assessing the Advanced Supply Chain Planning initiatives undertaken by Construction Companies in Kuwait involved in Commercial / Industrial construction activities.

**7. Research Methodology**

A pilot survey was conducted using a close-ended questionnaire based on 5-point attitude measurement scale among the Supply Chain Staff of 30 Construction companies in Kuwait (Construction companies having turnover of more than USD 10 Million dollars) selected on convenience sampling to measure the effectiveness of the Advanced Supply Chain Planning initiatives. In addition to the above, the available secondary data related to Supply Chain & Inventory Management from leading management journals, books and online publications has been used to support the objectives and methodology of study.

**8. Data Analysis**

Based on the collected statistical analysis was performed to test the hypothesis and arrive at conclusions on the application of "Advanced Supply Chain Planning" among the Construction companies in Kuwait.

The frequency of respondents Position shows that there are 5 Material Control Superintendents, 16 Material Control Supervisors, 5 Asst Material Control Supervisors and 4 Store Keepers and Material Control Supervisors represent 50% each of the total sample. The 30 respondents in the survey have a mean experience of 15.3 years. For the four variables of "Awareness levels of Advanced Supply Chain Planning tools" (Table 1.0 and Table 2.0) i.e. Selective Inventory Control (SIC), Vendor Managed Inventory (VMI), Min-Max Planning (Min Max) and Material Requirement Planning (MRP), the results show that Advanced Supply Chain Level of awareness for Vendor Managed Inventory is highest (Mean = 3.40; Median = 3.50), followed by Material Requirement Planning (Mean = 2.93; Median = 3.00), Min-Max Planning (Mean = 2.80; Median = 3.00) and Selective Inventory Control (Mean = 2.66; Median = 3.00).

**Table – 1 Descriptive Statistics – Awareness Level of ASCP**

| | | Years of Experience | SIC | VMI | Min-Max | MRP |
|---|---|---|---|---|---|---|
| N | Valid | 30 | 30 | 30 | 30 | 30 |
| | Missing | 0 | 0 | 0 | 0 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| Mean | 15.3667 | 2.6667 | 3.4000 | 2.8000 | 2.9333 |
| Median | 15.0000 | 3.0000 | 3.5000 | 3.0000 | 3.0000 |
| Mode | 10.00(a) | 3.00 | 2.00 | 2.00 | 4.00 |
| Std. Deviation | 6.66169 | .88409 | 1.19193 | 1.09545 | 1.28475 |

**Table – 2 ASCP Awareness Level**

| Awareness Distribution | SIC | VMI | Min-Max | MRP |
|---|---|---|---|---|
| Not Aware | 10.00 | - | 6.70 | 16.70 |
| Limited Knowledge | 30.00 | 33.30 | 40.00 | 23.30 |
| Moderately Used | 43.30 | 16.70 | 30.00 | 20.00 |
| Frequently Used | 16.70 | 26.70 | 13.30 | 30.00 |
| Daily Used | - | 23.30 | 10.00 | 10.00 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |

For the four variables of "Levels of Improvement Required for Advanced Supply Chain Planning"(Table 3.0 and Table 4.0) i.e. Selective Inventory Control, Vendor Managed Inventory, Min-Max Planning and Material Requirement Planning, the results show that Improvement Required Level for Min-Max Planning and Vendor Managed Inventory is highest (Mean = 3.00; Median = 3.00), followed by Material Requirement Planning (Mean = 2.87; Median = 3.00), and Selective Inventory Control (Mean = 2.80; Median = 2.00).

**Table – 3 Descriptive Statistics – Improvements for ASCP**

| | | Years of Experience | SIC | VMI | Min-Max | MRP |
|---|---|---|---|---|---|---|
| N | Valid | 30 | 30 | 30 | 30 | 30 |
| | Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | | 15.3667 | 2.8000 | 2.8667 | 3.0333 | 2.8667 |
| Median | | 15.0000 | 2.0000 | 3.0000 | 3.0000 | 3.0000 |
| Mode | | 10.00(a) | 2.00 | 3.00 | 4.00 | 2.00(a) |
| Std. Deviation | | 6.66169 | 1.21485 | 1.04166 | 1.15917 | 1.07425 |

**Table – 4 ASCP – Level of Improvement Required**

| Improvement Distribution | VMI | Min-Max | MRP | SIC |
|---|---|---|---|---|
| Improvement Not Required | 10.00 | 10.00 | 10.00 | 10.00 |
| Improvement can be considered | 26.70 | 26.70 | 30.00 | 26.70 |
| Improvement required | 33.30 | 20.00 | 26.70 | 30.00 |
| Improvement is essential | 26.70 | 36.70 | 30.00 | 20.00 |
| Improvement is very much essential | 3.30 | 6.70 | 3.30 | 13.30 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |

For the four variables of "Barriers for usage of Advanced Supply Chain Planning tools" (Table 5.0 and Table 6.0) i.e. Selective Inventory Control, Vendor Managed Inventory, Min-Max Planning and Material Requirement Planning, the results show that Advanced Supply Chain planning tools Level of barriers are in the same range for all variables i.e. Vendor Managed Inventory (Mean = 2.76; Median = 3.00), Material Requirement Planning (Mean = 2.70; Median = 3.00), Min-Max Planning (Mean = 3.03; Median = 3.00) and Selective Inventory Control (Mean = 2.96; Median = 3.00)

**Table – 5 Descriptive Statistics – Barriers for ASCP**

| | | Years of Experience | VMI | SIC | Min Max | MRP |
|---|---|---|---|---|---|---|
| N | Valid | 30 | 30 | 30 | 30 | 30 |
| | Missing | 0 | 0 | 0 | 0 | 0 |
| Mean | | 15.3667 | 2.7667 | 2.9667 | 3.0333 | 2.7000 |
| Median | | 15.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 |
| Mode | | 10.00(a) | 3.00 | 3.00 | 3.00 | 3.00 |
| Std. Deviation | | 6.66169 | 1.40647 | 1.35146 | 1.35146 | 1.20773 |

**Table – 6 Barriers for ASCP**

| Barrier Distribution | VMI | SIC | Min-Max | MRP |
|---|---|---|---|---|
| Lack of Training | 26.7 | 20 | 16.7 | 16.7 |
| Lack of basic conceptual knowledge | 10 | 13.3 | 16.7 | 23.3 |
| Not related to my day to day work | 43.3 | 33.3 | 33.3 | 43.3 |
| No initiative from the line management | | 16.7 | 13.3 | 3.3 |
| No Barriers | 20 | 16.7 | 20 | 13.3 |
| Total | 100 | 100 | 100 | 100 |

Using the data collected for the Barriers received by the Material Control staff to use the Advanced Supply Chain Planning tools, we have predicted the level of responsibility attributed to the awareness of Vendor Managed Agreements, from the perceived barrier scores obtained from three inter-correlated variables of Vendor Managed Agreements, Selective provocation, and Min-Max Planning. Specifically, the level of responsibility attributed by a subject who strongly believes that the Awareness on Vendor Managed Inventory, Selective Inventory Control and Min-Max Planning was motivated by perceived barriers for the usage of Vendor Managed Agreement, Selective Inventory Control and Min- Max planning. Attribution of responsibility is measured on 5-point scale, with 1 = Lack of Training to 5 = No perceived barriers.

To predict the level of responsibility attributed from these three strategies, by using the values presented in the Unstandardized Coefficients column (Table 7.0 and Table 8.0) for Model 1. Using the Constant and B (un-standardized coefficient) values, the prediction equation would be:

**Predicted responsibility attribution = 2.896 + (-0.176 × Selective Inventory Control) + (-0.32 × Vendor Managed Agreements) + (0.368 × Min-Max Planning)**

**Table – 7**
**Coefficients (a) – Regression for predicting the awareness level from barriers for ASCP**

| Model | | Un standardized Coefficients | | Standardized Coefficients | t | Sig. | 95% Confidence Interval for B | | Co linearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound | Tolerance | VIF |
| 1 | (Constant) | 2.976 | .487 | | 6.108 | .000 | 1.978 | 3.974 | | |
| | Barriers for adoption of VMI | .153 | .158 | .181 | .974 | .338 | -.169 | .476 | 1.000 | 1.000 |
| 2 | (Constant) | 3.011 | .587 | | 5.127 | .000 | 1.806 | 4.216 | | |
| | Barriers for adoption of VMI | .164 | .186 | .193 | .883 | .385 | -.217 | .545 | .746 | 1.340 |
| | Barriers for adoption of SICI | -.022 | .193 | -.025 | -.113 | .911 | -.418 | .375 | .746 | 1.340 |
| 3 | (Constant) | 2.896 | .591 | | 4.898 | .000 | 1.680 | 4.111 | | |
| | Barriers for adoption of VMI | -.032 | .248 | -.038 | -.129 | .898 | -.543 | .478 | .411 | 2.433 |
| | Barriers for adoption of SICI | -.176 | .232 | -.200 | -.758 | .455 | -.654 | .302 | .509 | 1.966 |
| | Barriers for adoption of MinMax | .368 | .312 | .417 | 1.177 | .250 | -.274 | 1.010 | .282 | 3.552 |

**Table – 8**
**Excluded Variables(c) - – Regression for predicting the awareness level from barriers for ASCP**

| Model | | Beta In | t | Sig. | Partial Correlation | Collinearity Statistics | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Tolerance | VIF | Minimum Tolerance |
| 1 | Barriers for adoption of SICI | -.025(a) | -.113 | .911 | -.022 | .746 | 1.340 | .746 |
| | Barriers for adoption of Min Max | .265(a) | .915 | .368 | .173 | .413 | 2.421 | .413 |
| 2 | Barriers for adoption of Min Max | .417(b) | 1.177 | .250 | .225 | .282 | 3.552 | .282 |

a Predictors in the Model: (Constant), Barriers for adoption of VMI, b Predictors in the Model: (Constant), Barriers for adoption of VMI, Barriers for adoption of SIC, c Dependent Variable: Vendor Managed inventory

Thus, for a subject who strongly believes that Awareness on Vendor Managed Inventory, Selective Inventory Control and Min-Max Planning was motivated by perceived barriers for the usage of Vendor Managed Agreement, Selective Inventory Control and Min- Max planning (a score of 1), the predicted level of responsibility attribution would be:

**Predicted responsibility attribution = 2.896 + (-0.176 × 1) + (-0.32 × 1) + (0.368 × 1) = 3.056**

Given that responsibility attribution is measured on a 5-point scale with 1 = Not aware to 5 = Daily used, a predicted value of 3.056 would suggest that the response of users who feels that usage of Vendor Managed Agreement, Selective Inventory Control and Min- Max planning is "Not related to my day to day work" evolved as a major motivator for the lack of Awareness of Vendor Managed Inventory.

The Kruskal–Wallis test is a nonparametric test that is used with an independent groups design comprising of more than two groups. It is a nonparametric version of the one-way ANOVA, and is calculated based on the sums of the ranks of the combined groups. We are interested in determining the effectiveness of three different range of experience of Material Controls staff on the awareness levels of Vendor Managed Inventory, Selective Inventory Control and Min-Max Planning. The scores recorded on the awareness levels of above variables is used to test the null hypothesis.

· Null Hypothesis (H0): There is no significance effect of experience on the awareness of Advanced Supply Chain Planning tools.

The obtained Kruskal-Wallis statistic Table 10.0 is interpreted as a chi-square value and is shown to be significant, $\chi2$ (df = 2) = 4.89, p > 0.01 for Selective Inventory Control, $\chi2$ (df = 2) = 0.808, p > 0.01 for Min-Max Planning and $\chi2$ (df = 2) = 3.59, p > 0.01 for Vendor Managed Inventory. Thus, it can be concluded that the three ranges of experiences has no significant effect with regard to the awareness levels of Vendor Managed Inventory, Selective Inventory Control and Min-Max Planning and the null hypothesis is accepted.

**Table – 9** Ranks

| | Experience Range | N | Mean Rank |
|---|---|---|---|
| Selective Inventory Control | Upto 10 Years | 8 | 15.00 |
| | From 11 to 15 Years | 9 | 11.00 |
| | More than 15 Years | 13 | 18.92 |
| | Total | 30 | |

**Table 10.0**
**Test Statistics(a,b)**

| | Selective Inventory Control |
|---|---|
| Chi-Square | 4.896 |
| df | 2 |
| Asymp. Sig. | .086 |

a Kruskal Wallis Test
b Grouping Variable: Experience Range

**9. Conclusions**

This study has provided a detailed insight on the various leading supply chain planning practices followed by Construction Companies in Kuwait. The study also provided an assessment on the performance of the various supply chain planning activities and suggested the areas of improvement required. Advanced Supply Chain Planning Level of awareness for Vendor Managed Inventory is highest, followed by Material Requirement Planning, Min-Max Planning, and Selective Inventory Control. It has been noted that there is 100% awareness among the respondents on Vendor Managed Inventory. Considering the high awareness level of VMI, Min-Max Planning, the respondents of the study suggested the highest level of Improvement required for the above supply chain planning tools.

The Analysis of Barriers indicates that the most of the respondents feel as it is not related to their Day to Day activities. The Construction companies in Kuwait have to implement strategies to improve the awareness level of important Advanced Supply Chain Planning tools such as Min-Max Planning, Selective Inventory Control. By using ASCP effectively through experienced staff, Construction Companies in Kuwait can successfully manage all aspects of their supply chain.

Construction Companies must understand the importance of being able to accurately calculate safety stock across their supply chain, taking into account service levels, uncertainty in demand, lead times, and capacities. This is not a simple task, but new tools and experienced supply chain executives determine and position of stock in their supply chain. The advanced supply chain tools also allow supply chain executives to evaluate the impact of changes in stock on supply chain performance.

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