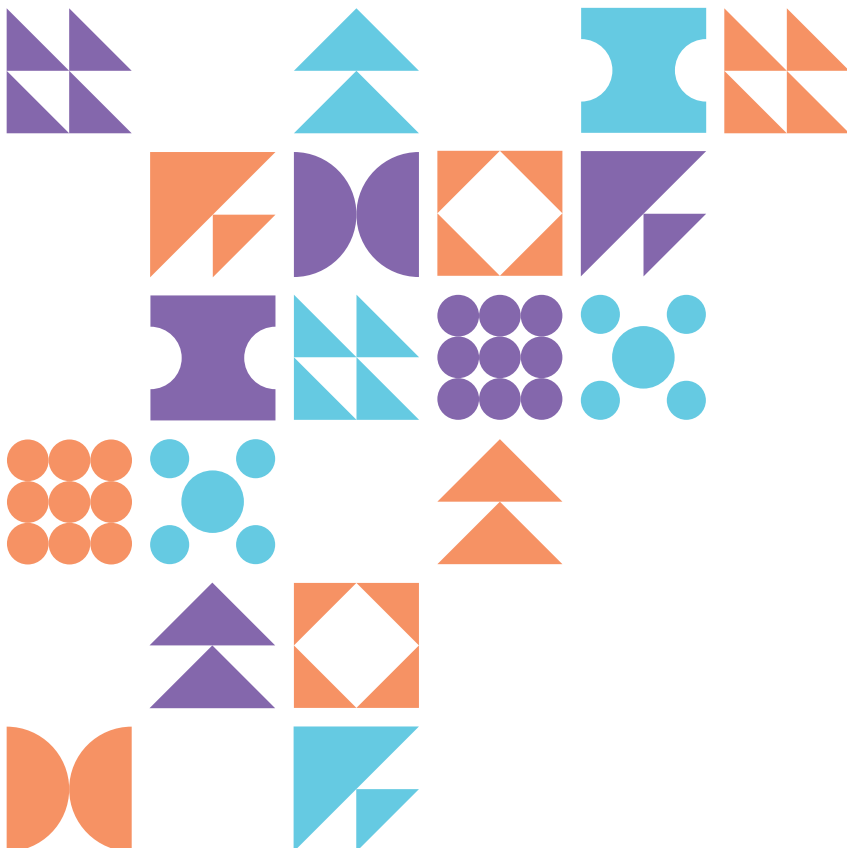




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Enhancement of Supply Chain in the Construction Industry

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ABSTRACT

The inevitable challenges being pressed by the construction industry in delivering the project with topmost quality considerably requires a responsive and effective supply chain management (SCM). Utilization of supply chain management should be vehemently emphasizing the utmost deriving effect in attaining an effective implementation of total integration among all related disciplined affiliates within the chain (suppliers, designers, vendors, contractors, subcontractors and client). Those multinational construction companies who were directly affected, have done their own extensive research which produces computer-based platforms as an undertaking that will hopefully address the sought-after ideal supply chain management concepts. Application of a more matured SCM from manufacturing industry posed a lot of persistent discrepancies when quasi implementation made the same with SCM in the construction industry. In-depth studies showed the most obscuring differences were instigated on the interfaces among numerous entities or functions within the link and the multifarious fauna of the construction atmosphere. The intention on this research is to expound any adaptable proposals for enhancing construction supply chain management.

1.0 Introduction

Supply chain management (SCM) in construction had been viewed and analyzed in comparison to a more stable manufacturing industry operation process. Research was focused on qualitative and quantitative approach. The quantitative model is empirical to inventory management, forecasting demand and augmentation of related information analysis in manufacturing practices. Qualitative research, a managerial aspect related to framework definitions, is applied to industry and so requires validation for its effectiveness through empirical research.

SCM in the construction industry has a unique distinction on its own as a project necessity that varies from other industries without any replication or redundancy of work. Research based on quantitative and qualitative modelling approaches couldn't even arguably fit construction applications owing to two (2) inherent intricacies:

- Distinct projects have their own issues with respect to standardization and modularization.
- Insufficient assimilation between stakeholders: design team, main contractors, subcontractors, vendors, suppliers, site team and the client.

This document had six supplementary segments. The second segment delivers delineation of the supply chain (SC) structure highlighting some issues and opportunities. The third section focuses on the role of the job in the supply chain. The fourth section describes in what way an enterprise attains a strategic fit among its supply chain strategy and its competitive strategy. The fifth section discusses the level of supply chain integration. The sixth section identifies three significant problems or opportunities in the supply chain as it evolves. The final segment includes research restrictions and advocates topics for further investigation.

The constancy of purpose was the basis of what Saudi Aramco is now known for. In 1933, the government of the Kingdom of Saudi Arabia collaborated with Standard Oil Company of California (SOCAL), a U.S.-based oil company. This partnership aimed at ensuring the Kingdom could develop its oil reserve potential.

With this, a subsidiary company, the California Arabian Standard Oil Company (CASOC) was formed to oversee and manage the agreement. After surveying, drilling for "black gold" commenced. In 1937, after two years passed without any positive outcome, SOCAL executives asked for further guidance from chief geologist Max Steineke, who said "continue drilling."



After a long year of hard work and tremendous perseverance, Saudi Arabia was able to hit the jackpot. The drillers luckily drilled their dream hole that was put to production from Dammam No. 7, which they fondly called the “Prosperity Well.”

Over the succeeding years, the company catapulted its production through a series of events that made Aramco what it is today.

Due to company expansion, I was hired as an engineer for the Projects Division under the umbrella of the Project Management Team. After years of experience and dedication to work, I am now serving as a project manager. I manage both small and larger budgeted projects in the range of \$300 to \$500 million including process line modification, firewater line modification and facilities to name a few.

Responsibilities for the success and failure of all aspects of the project undertaken include: Project controls, project administration, contract administration, HSE, material procurement and supply chain management, scope management, quality, overall performance reporting, pre-commissioning/commissioning and project handover to proponent, accountability to make project management-level decisions, address/mitigate project risks and execution at division Level.

1.2 Features of Construction Supply Chains

Manufacturing and construction are two distinct industries, though the former is well established, this can also be replicated with the construction industry in terms of other methodologies but the same proposition [O’Brien, (1999)]. This motivation is promising enough to make sure the incorporation of entities (suppliers, designers, vendors, contractors, subcontractors and clients) be it be external and internal in nature.

To be specific about the difference between SCM in the manufacturing and construction industries; the product involved for the manufacturing is a tangible item that can be produced repeatedly as in production lines, while the product for construction is the whole delivery of the project itself.

Some variances concerning supply chain in manufacturing and construction are:

- Product produced only intended for a particular client. Product has inherent differences for every execution of the project.
- Venues, facilities and requirements vary for each venture.
- Personnel requirements to accomplish the project is dependent upon the job to be performed with a high rotation index.
- Materials and parts sometimes can’t be stored at site.

The construction supply chain is categorized in relation to assembly and purpose by these fundamentals [Vrijhoef et al., (2000)]:

- A product to be made is a congregation of different materials that would be assembled on site.
- The sequence of processes in a construction supply chain is only formed in accordance with actual requirements. A provisional supply chain producing unrepeated product would only be facilitated to cater to the unique needs of the project at hand.
- Most fabrication is done on demand and only according to specifics as per project requirements.



1.3 Main goals of supply chain management

1.3.1 Collaborative Efficiency

To have efficient supply chain management, an organization must include inventory supervision to make synchronizing logistics and the supply chain much easier.

1.3.2 Higher Quality

A collective effort from all concerned entities along the supply chain must be able to provide the best value to the client. Retailers must be close enough to the customer to get the feedback at a reasonable time to affect changes when required.

1.3.3 Enable Financial Success

The most remarkable achievement a supply chain can have is to have commercial success by managing inventory cost, employment incidentals and logistical expenses.

1.3.4 Stability

The last challenge that needs to be addressed is the viability for the business and customer gratification.

Goals can be achieved through information assimilation of the enterprise, functional coordination, collaboration, single-mindedness toward the client and enhancement of overall schemes inside the supply chain [Ross, (1998), La Londe, (1998), Lee and Whang, (2001), Roth and Martin, (2000)].

2.0 Structure of Construction Supply Chains

Figure 1 denotes a system with multiple supplier-client relationship samples that required project completion. Correlation ambiguities among the different entities within the loop that upset the well-being of the supply chain were conveyed by copious writers [Vrijhoef and Koskela, (1999), Vrijhoef, (1998), Hong-Minh et al., (2000); Akintoye et al., (2000), O'Brien, (1999), Ofori, (2000), Vrijhoef et al., (2001)]. Problems occurred not in the transformation process but with diverse borders of entities. Refer to Figure 1 for more details.

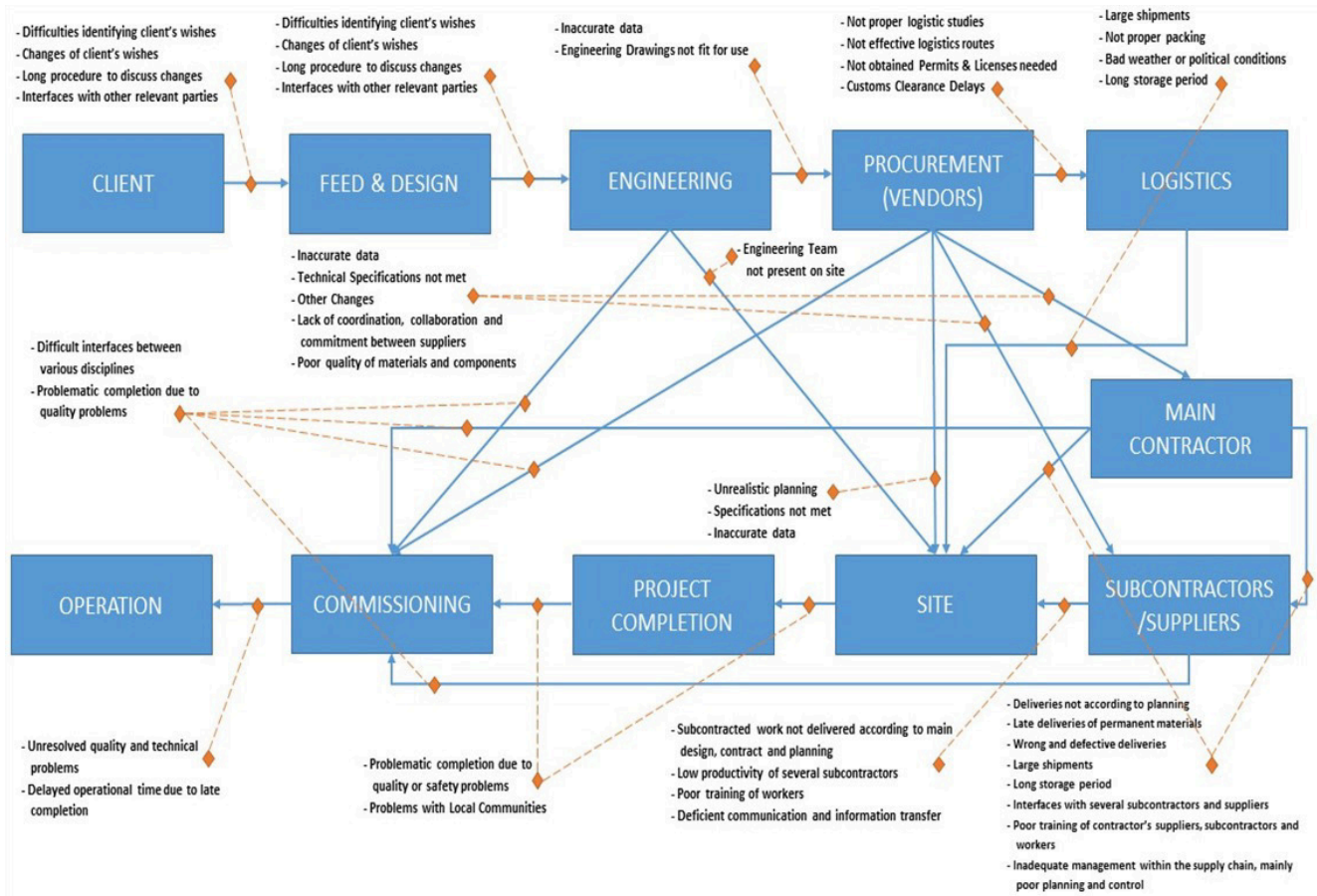


Figure 1. Sample of a system of multiple supplier-client relationship

3.0 Job Role Relationship to Supply Chain Management

The role being portrayed under my jurisdiction was overseeing the overall performance of the construction team with respect to the delivery of the project on time, within scope, within budget, conducted in a safely manner and of high quality as expected by the proponent. As mandated by Saudi Aramco, all activities involved should adhere to the stipulated Operational Excellence in delivering the project. This focuses both construction and supply chain management in a synchronized fashion to accentuate the targeted goal of producing to the optimum level project at as one unique product.

An organizational structure and delegate are required, along with a multidisciplined workforce that will enable inner workings of the projects. There should also be a prioritization of known long-lead materials for on-time deliveries so as to smoothen the flow of project events as planned. Organized site visits to any factories to enliven the progress for a real-time installation onsite and sequence of events should be followed as planned. As well as this, there should be close harmony with construction personnel for the deliverables of materials in case of any disruption or changes to the delivery schedules. Site work would be adapted to the new forecast delivery and that immediate response will not pose due impact to the overall progress of the project.



4.0 Achieving strategic fit

Both supply chain and competitive strategy should be aligned and have the same goals to succeed.

There are three elementary stages in attaining strategic fit:

- Comprehending the customer and supply chain uncertainty.
- Recognizing the supply chain capabilities.
- Attaining strategic fit.

4.1 Comprehending the customer and supply chain uncertainty:

The supply chain uncertainty helps the company identify the extent of disruptions and delay the supply chain must be prepared for. Several attributes include the following:

- Determining the demand quantity of services or goods required for each order.
- Ascertaining to total response time of the delivery of the product.
- Determining the assortment of the requirements.
- The level of appropriateness of the provision.
- The value of the proposition.
- Determining the technology application.
- The expected total value of the product.

4.2 Recognizing the supply chain capabilities:

Implementation requirement of the supply chain should be tailor fitted in accordance with the sensitivity of the demand:

- Rejoining all necessary features as required.
- Able to meet the stringent schedule given.
- Ability to handle a magnitude of demand either by quantities or assignment implementation.
- Capacity to deliver highest quality to the client.
- Able to manage and absorb unprecedented demand.



Figure 4.3: Attaining strategic fit

The supply chain for materials used in construction aren't much affected by the "bullwhip effect." Some materials are only accommodated just in case additional items are added for constructability purposes. Those items were already mitigated as part of the ample spares mandated by Saudi Aramco standards.

To reduce the undesirable effect or harm of your financial outlay that will consequently dent your capitalization, higher inventory would be controlled to reflect the realistic demand of the market at a given time. A corresponding determination of the actual veracities of data and information coming from the supply chain associates is much regarded as the basis of decision making to be pursued.

Established ways were being followed to lessen the impact of the bullwhip effect in any business. For example, these two (2) types of supply chain were enumerated:

1) Push types supply chain: a forecast made without an actual demand. Only a pretension the demand is forthcoming.

2) Pull types supply chain: an actual and present demand of the market. An instruction with confirmation to produce or fabricate the product.

Under this type of supply chain, the bullwhip effect is minimized due to a verified demand and not a mere prediction.

5.0 Level of Supply Chain Integration

The adaptation of integrated processes as an accepted core in supply chain catapulted its effective execution of supply chain management commencing from sourcing, fabrication and its dissemination throughout the link (Cooper et al., 1997; Ellram and Cooper, 1990; Mentzer et al., 2001). Aside from the adapted integration model, an extensive latitude reaches out by incorporating supplier and customer interaction (Flynn et al., 2010; Zhao et al., 2010). Dedicated motivation was being intertwined on integration, cooperation and coordination all throughout the value chain (Stank, Keller, and Daugherty 2001, p. 30).

Principle of SCI is teamwork, mutual understanding, shared vision vision/technology and the belief of trust for both manufacturer and client (Flynn et al., 2010).

The purpose of the SCI is to attain precise, sensible and impeccable stream of merchandises and facilities, data, cash and procedures, to convey determined significance to the consumer at affordable cost, least time in a proficient means (Bowersox et al., 1999; Frohlich and Westbrook, 2001; Naylor et al., 1999).



5.1 The Supply Chain Integration with Saudi Aramco

Saudi Aramco always finds ways to simplify things for all stakeholders from project conception to project delivery and operation. The old SAP Core System, which already integrates most of the processes, was upgraded to Oracle Primavera P6. The current infrastructure was integrated to a more robust database software for a more intensive and in-depth approach of application towards automation processes with less manual intervention.

5.2 Enterprise Project Management (EPM)

EPM is an IT enabled business transformation solution for Saudi Aramco Project Management. It introduces structured project management business processes, enabling continuous improvement using standardized and integrated information systems for efficient and consistent delivery of Saudi Aramco's capital projects. It also enhances the efficiency of capital project management and delivery from Preliminary Engineering to the Project Closeout with Value Assurance Reviews. It uses integrated processes, people, and technology built around the best-of-breed commercial-off-the-shelf (COTS) applications.

This enables the integration of business processes, data and technology to support the efficient and consistent delivery of Saudi Aramco's capital projects. It also automates workflows and the transfer of data between EPM application suites to minimize manual intervention. This standardizes project controls and execution through common processes, templates and reports across project types and contracting strategies.

Figure 2 shows department scope related to project execution. This is an internalized structured process involving design, procurement and project building. Initially, Project Controls established all efforts that need to be measured for all task dependencies for the whole project life cycle. Once keyed into the system, it automatically assesses updated reports, analytics and metrics. It goes the same within Project Administration, Safety, Quality and Asset Information. All these intercorrelated functions within a project were being monitored, controlled and mitigated in between by PMT personnel, stakeholders and contractors in the most efficient manner. All project entities are required to converge with a common platform that unifies solutions that will result in making an informed decision. This is how supply chain integration is currently being pursued and coordinated within Saudi Aramco projects with all its stakeholders, be it be products/goods, service flows, information flows and fostering a good relationship to create better value for all partners.



EPM Project Scope

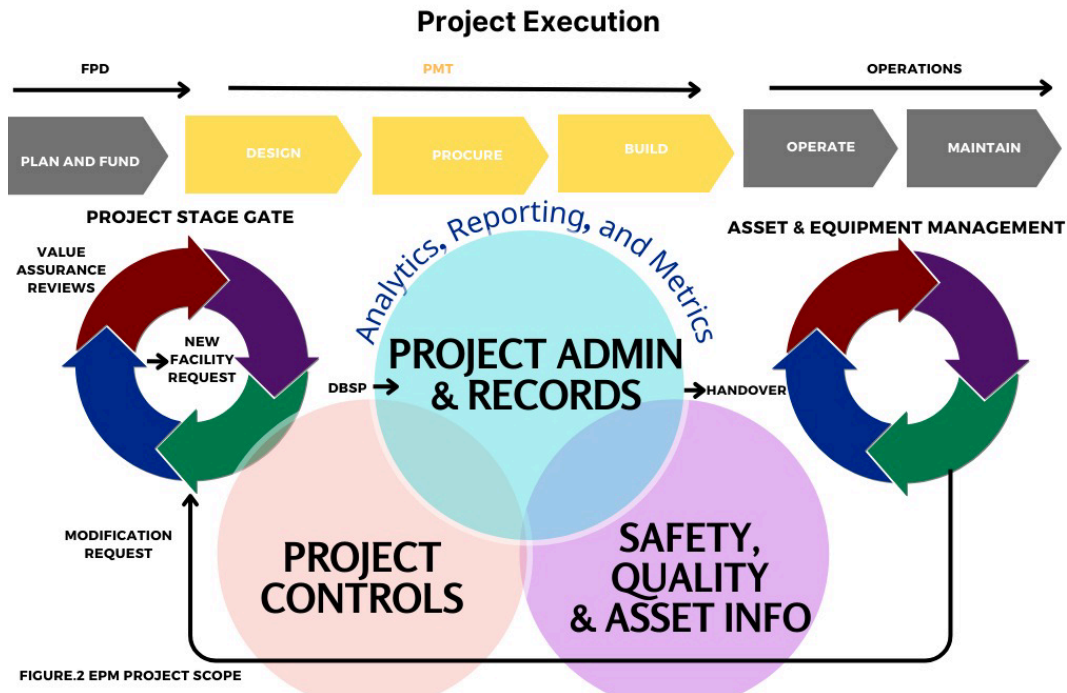


Figure 2. EPM Project Scope

Excerpts figures below illustrates an EPM Solution Overview (Figure 3) and Material Management Flows (Figure 4).

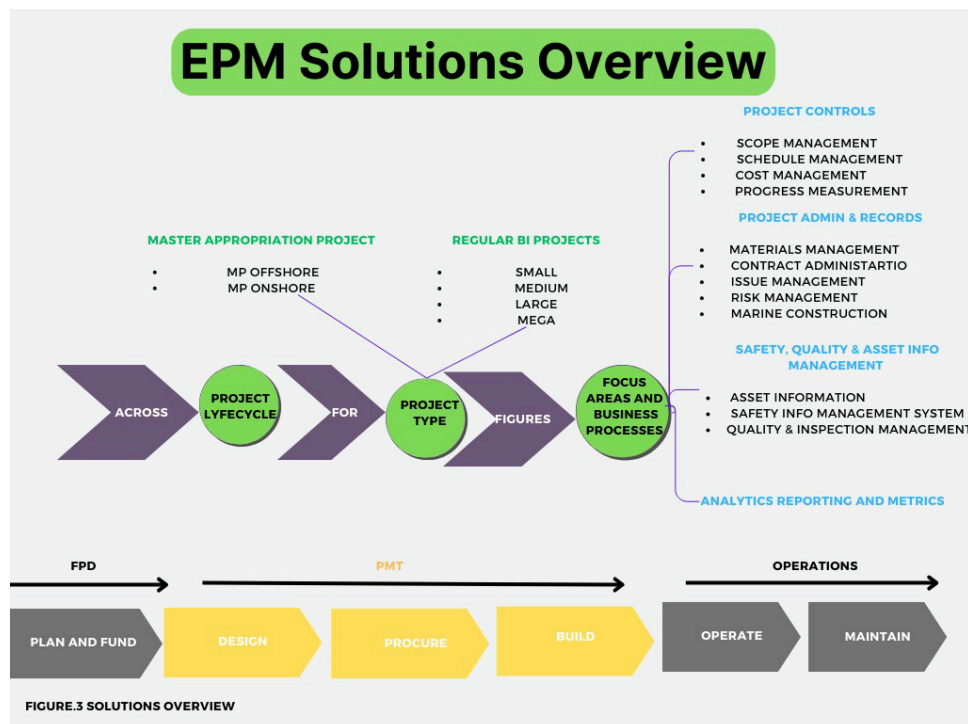


Figure 3: EPM Solution Overview



SAP

EPM Material Management



FIGURE.4 MATERIAL MANAGEMENT

Figure 4: Material Management



6.0 Developments in Construction Supply Chain

6.1 Present Research Status

The supply chain process in the construction industry lacks academic studies in terms of improvement. Early SCM metrics were offered by [Beamon, (1999)]. In succession, an illustration of links inside the supply chain with its hierarchical levels was developed by [Gunasekaran et al., (2004)]. This has brought the distinction of keywords in the process: plan, source, make/assemble, and delivery of the product. Inner workings were being implemented with diverse viewpoints as with operational, tactical and strategic aspects. Additional interpretation was concocted by [Vachon et al., (2009)] by retracing the matter of competitive urgencies and the exploitation of metrics. That resulted in widespread rejoinder that was accepted by the business sector.

6.2 Approaches How to Develop Supply Chain Management

To achieve a rewarding outlook in the supply chain industry, the adaptation of a newer applicable scheme for inoculating a workable supply chain management would be beneficial by developing a structured approach method among the construction companies and with their contractors, consequential to an enhanced capability of the whole supply chain.

6.2.1. Supplier and Subcontractor Advancement

There should be an incessant interaction of both parties (construction companies and contractors) for the whole duration of a project. The deliverance of a successful project is totally dependent on the contractor's proactive response to all undertakings. Initiatives should be put in place and nurtured to accommodate and foster development.

6.2.2 Bench Marking

Measuring the performance of any process is a challenge. The cumbersome portion of the situation is how to describe the metrics that will hasten the effective usage of information for process improvement.

6.2.3 Knowledge Management

The supply chain management should be pursued from the construction company's perspective. The bulk of the knowledge is abundant and is intact within the company. As with Saudi Aramco, it can clearly define an effective solution to address the need. Even though EPM was in place, it's an indicator for a more inclusive approach between construction company and contractor. The platform at hand should not stop realigning, tweaking and fine-tuning until focused direction can be achieved.



7.0 Conclusions

Supply chain management in the construction industry is very complex in nature. A lot of approaches have been instituted and applied to lessen its impact with due care in delivering projects on time. Implementation of EPM by Saudi Aramco is helping toward a reachable solution in project management concerns. Still, there are a lot of unattended issues that still linger. Contractor to subcontractor coordination and below intermediaries still require more upbeat realigning each other's focus toward a single-minded effect in producing the end product.

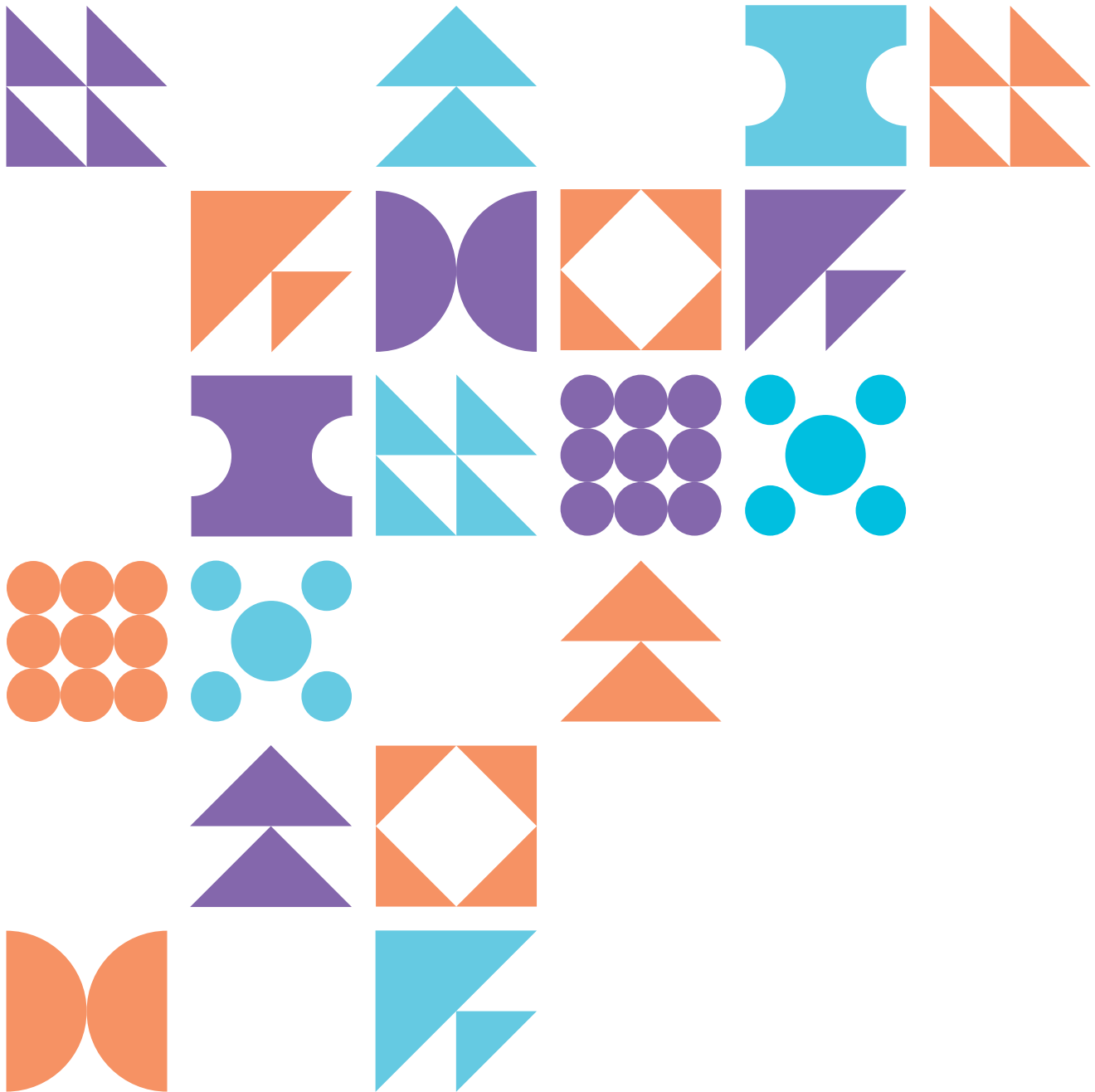
The overall efforts in enhancing the SCM in construction is an ongoing process until measurable results that have an impact are felt. These could include abridged factual expenses, less manual intervention, enticement of eliminating surplus from the process, economical gains, better yield viability, conveyance of a much value-added product to the client, realistic delivery, throughput improvement, further business recurrence with key clients, grander self-assurance to life-long planning and healthier association among parties.

Since the basis of knowledge was taken from a manufacturing point of view and applied to the construction industry, further research of the modular approach of SCM dedicated to construction may be required.



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