

Interface Management on Megaprojects: A Case Study

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Mega-construction projects are inherently complex and large in scale, thus requiring increased efforts in project management processes. Interface management systems have been studied as possible solutions to helping effectively manage complex megaprojects. This paper takes a brief look at a megaproject that developed an interface management system as a means of overseeing the numerous organizational interfaces that existed amongst project participants. The purpose of this paper is to evaluate first, how closely the projects' management plan incorporated current interface management system models, and second, how effectively the project's participants implemented the interface management plan. This paper explores the interface model that was developed and reports on interviews that were conducted with major stakeholders to determine the effectiveness of implementing the plan.

Key Words: Megaprojects, Interface Management, Work Breakdown, Project Management

Introduction

Construction projects are inherently complex in nature because they are typically set up with temporary, multi-organizations working in uncontrolled environments. However, large and complex construction projects typically require even more concerted efforts in project management practices because of the greater magnitude of the project scope or the intricate nature of organizing and facilitating unique or difficult tasks. An effective way of managing complex projects is to break them down into manageable sizes using a work breakdown structure, which is "a deliverable-oriented grouping of project elements, which organizes and defines the structure of the entire project" (Jung and Woo, 2004). More recently, industry leaders and scholars have been studying the implementation of interface management systems, a means of recognizing and communicating the "interfaces existing between project parties and construction components" (Shokri, et al, 2012), to facilitate the management of large complex construction projects. The purpose of this paper is to provide a brief case study on a current megaproject that has implemented the use of interface management systems.

Background of Interface Management

Interface Management

The management of construction projects is complicated because it requires bringing together independent multi-disciplinary teams, materials, systems, budgets, and schedules for a determinate amount of time. The nature of construction is such that there are many uncontrolled variables, further complicating the process. In the act of bringing multi-organizational teams and complicated materials together, several interfaces, or interactions, are temporarily created. Pavitt and Gibb (2003) describe three general types of interfaces that exist in a construction project, including physical, contractual, and organizational interfaces. Physical interfaces are the actual, physical connections that exist between building elements or components. Contractual interfaces are work elements that are grouped into distinct work packages by contract. Lastly, organizational interfaces are the interactions that occur between the different people associated with the construction project. More specifically, these organizational interfaces are the "contact points between relatively autonomous organizations which are interdependent and interacting to achieve some larger objectives" (Wren, 1967). Chua and Godinot (2006) further defined project interfaces to include time interfaces that effect the transition from a certain kind of activity to another, geographical interfaces that separate on-site and off-site work, technical interfaces that set the limits of a system's subcomponents, and organizational interfaces that keep groups of people apart. Interface management is then simply the idea of organizing a complex project into definable interface points, and managing all communication, responsibilities, and coordination associated with these interdependent parts. Siao and Lin (2012) have suggested

that one approach is through the use of a multilevel interface matrix to appropriately account for the interdependent nature of various project interfaces.

Organizational project interfaces can exist either internally or externally to the project. Shokri et al (2012) indicated that this occurs at one of three different levels: "inter-project" where interfaces occur between different parties directly involved in project planning and execution, "intra-project" where interfaces occur within the organizational framework of each independent party, or "extra-project" where interfaces occur between project parties and other parties/organizations not directly involved in project execution (such as government permitting agencies or environmental organizations). For the duration of the project, the individual parties must collaborate and depend on the others for successful projection completion, requiring open communication and interfacing amongst each other. In essence, organizations become "systems of mutually dependent variables" (Chua and Godinot, 2006). Organizational interface management is used as a process of managing these temporary relationships, defining the routing of communications and project documentation, and other aspects of the organizational relationships that are interdependent of each other.

Interface Management in Construction

In recent years interface management has been researched as a means of improving the efficiency of construction projects, but is still a relatively new topic within the construction industry. Other management models, such as lean construction and agile project management, have been applied to the construction industry with some success for many years. Lean production began as a manufacturing philosophy in Japan in the early 1950's, and many of the same philosophies such as just-in-time ordering, value-engineering, and total quality management are now used regularly within the construction industry. The principle goal of lean production is to avoid wasting time, money, and equipment on any given project (Senaratne and Ekanayake, 2012). Agile project management, on the other hand, utilizes the idea of iteration and incremental development for managing design and construction activities. It is typically easier to apply these other management philosophies to smaller commercial or residential construction projects where repetition is more prevalent. On the other hand, it is difficult to develop these other management models within the context of large and complex construction projects. It is for this reason that the use of interface management continues to be explored as a means of improving construction efficiency.

Megaprojects

Megaprojects are typically defined as any project that is extremely large in scale, and are often infrastructure projects like roads, bridges, airports, tunnels, and utility systems. The term megaproject is also often associated with petroleum, mining, or other heavy industrial projects. These types of projects are typically complicated by their geographic locations, multi-organizational teams, complex technologies, expense, project duration, and difficult permitting processes. Typically there is a correlation between the complexity of the project and the complexity of the required interfaces. Much of the research regarding how interface management can be implemented within the construction industry is specifically targeted at megaprojects. Chen et al (2007) has described the benefits of utilizing interface management on large complicated construction projects, including the following:

- *"Build a deep understanding of project complexity for project participants*
- *Optimize design in terms of quality, compatibility, constructability, cost, risk, and function to meet customer needs*
- *Improve project planning by avoiding, minimizing, or eliminating potentials for interface issues in advance*
- *Build and maintain desirable relationships and interaction channels among project participants to achieve timely communication, coordination, and cooperation*
- *Standardize the handling process and work flows for various types of interfaces in construction projects and reduce uncertainties*
- *Enable a dynamic and well-coordinated construction project delivery system when responding to changes*
- *Identify and record good practices in dealing with project complexity and reapply them in future projects"*

Despite the stated benefits of using interface management, the effective implementation can still be problematic. For example, one current problem with implementing an interface management system on large-scale projects is simply the lack of information on how it should be appropriately done. Much of the recent research on interface management in the construction industry is centered on the best practices of its implementation.

Work Breakdown Structure Model

The early implementation of interface management within a construction project has been found to be more effective than attempting to do so later. Initial implementation often occurs by implementing the interface management through some sort of work breakdown structure, or simply put, breaking down a project into smaller more manageable pieces. Shokri et al (2012) has identified the five different steps for interface management that should take place during the project lifecycle. These include:

- Step 1 – Interface Identification: Identify as many interfaces as possible.
- Step 2 – Interface Documentation: Define the interface information.
- Step 3 – Interface Transferring: Transfer the identified information to the appropriate parties.
- Step 4 – Interface Communication: Parties use interface agreements to effectively manage interfaces.
- Step 5 – Interface Closing: Interfaces are considered closed when agreement of all parties is reached.

The Project Management Institute (PMI, 2013) has further defined interface management procedures in their Project Management Book of Knowledge (PMBOK). The PMI model follows a basic work breakdown of a construction project, or in other words developing a "hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables. Other tools such as a RASCI (Responsible, Accountable, Support, Consulted, and Informed, respectively) Matrix help to further define roles and responsibilities at each interface point. This provides the project team the ability to define the participation roles in completing tasks for the project. These relationships, lines of communication, and responsibilities are easily visualized in organizational charts.

Case Study

The principal purpose of this paper is to analyze the implementation of a recent megaproject that followed the Project Management Institute model in defining its interface management system. This particular project is a major industrial expansion project in the Western United States. However, due to the sensitive and proprietary nature of the project, the project's principals have requested that names and detailed information about this project be kept confidential. Some of the basic, public facts about the project in the context of this paper include:

- This project met the megaproject definitions included within this paper.
- This project was a large industrial expansion which included significant time and effort in infrastructure and vertical construction.
- Multiple contractors, subcontractors, engineering firms, internal management teams were involved.
- Several municipalities, government entities, and environmental agencies, were also involved in the permitting process of this project.

For the sake of this analysis, full access was granted to the project's management plan, which included a detailed work breakdown structure of the project. Detailed interface management systems that identified the interfaces between all stakeholders were also included in the project management plan. This case study briefly addresses two different items: first, how closely the project's management plan incorporated current interface management system models, and second, the practical implementation of the current interface management plan by the project's participants.

Project Management Plan Analysis

This expansion project used for this case study, referred to as P1 within this paper, was fortunate enough to have a management team with vision, policies, and procedures in place. This facilitated the early development of a detailed project management plan (PMP). P1's project management plan was essentially a detailed plan that outlined everything from permitting to completion, along with defining the relationships of all the stakeholders involved. The general items covered within the PMP included the roles & responsibilities of participants, project description and scope, the expectations for communication between stakeholders, safety plans and responsibilities, permitting and

environmental issues, project organization and controls, information and document management, commissioning and start-up, project closeout, and many other essential items.

P1's organizational chart included not only the current team members, but also potential future positions to be filled as the project progressed. Intra-project, inter-project, and extra-project interfaces were clearly defined in the PMP. A unique feature that led to the success of this project was that the PMP was managed online with secured access. This allowed a greater level of visibility for all parties involved. The PMP itself was managed at a single source and was updated constantly with the most current information, thus allowing for a dynamic and evolving project. For example, when a stakeholder was brought on board, their name was then simply inserted into the applicable placeholder in the organization chart. Because the roles and responsibilities of project parties were clearly defined and visible to others, this helped eliminate ambiguity between all parties involved. Stakeholders were encouraged to regularly view the PMP online to stay familiar with the most recent version.

Training was identified as another benefit of such a detailed PMP. When new stakeholders became involved with the project, having everything spelled out in the PMP made it possible to quickly get them up to speed and identify and understand their specific roles and responsibilities. The learning curve for new team members was greatly shortened with so much visibility. Whenever information was needed, it was easy to identify which interface point to go to in order to obtain the necessary information. "Inter", "intra", and "extra" -interfaces were also identified in the organizational chart. Figure 1 demonstrates an example of the detail included within P1's organizational chart and in particular with the organizational interfaces.

Another benefit identified because of the early implementation of P1's PMP was that schedules and budgets were given sufficient time for development, including a greater level of detail. It was also apparent that necessary financial and human resources had been planned, and that long lead items had been procured in a timely manner. There appeared to be a higher level of project performance due to having a detailed PMP in place early on in the project. One of the benefits was having standardized work practices and communication procedures in place up front. Standardized forms were also beneficial. No enterprise wide software was used on this project, so the standardized forms were necessary to ensure that everyone was using the same forms and documents. The work breakdown structure, though detailed, was modified several times to account for scope clarifications and adjustments.

Personnel Interviews

Besides understanding what was in the interface management plan, it was also important to determine its effectiveness in application. To identify the effectiveness of the interface management system that had been developed, interviews were conducted with several key individuals with the sole intent of learning from their individual experiences. Four different stakeholders were interviewed including a principle project manager, a procurement manager, the PMP's interface manager, and a permit manager.

The principle project manager (PM) that was interviewed was extremely familiar with the project management plan. In fact, this individual indicated that they had participated in the initial development of the plan while working outside of the country on another project. The project manager indicated that the Project Management Institute's Body of Knowledge (PMBOK) was the guiding document used in preparing the PMP. This PMP, though all-encompassing, was designed to be dynamic throughout the progression of the project. One of the main concerns during development of this document was flexibility. This individual further indicated the need for formal training on the PMP and all of its content, and that specific training while onboarding new stakeholders was a little lacking.

The second interview was conducted with a senior procurement manager, who was integral in the purchasing of materials and services for portions of this project. This individual expressed concerns with the complexity of the interfaces that had been put in place for the purchasing of materials and services. These interfaces included several layers of checks and balances, including a legal team that was outside of the country. One of the problems this individual had to deal with was purchasing processes getting bottlenecked at one of the interface points. Working with multiple interface points had taken a process that would normally get done in a single week and had extended the duration of that process up to about three weeks.

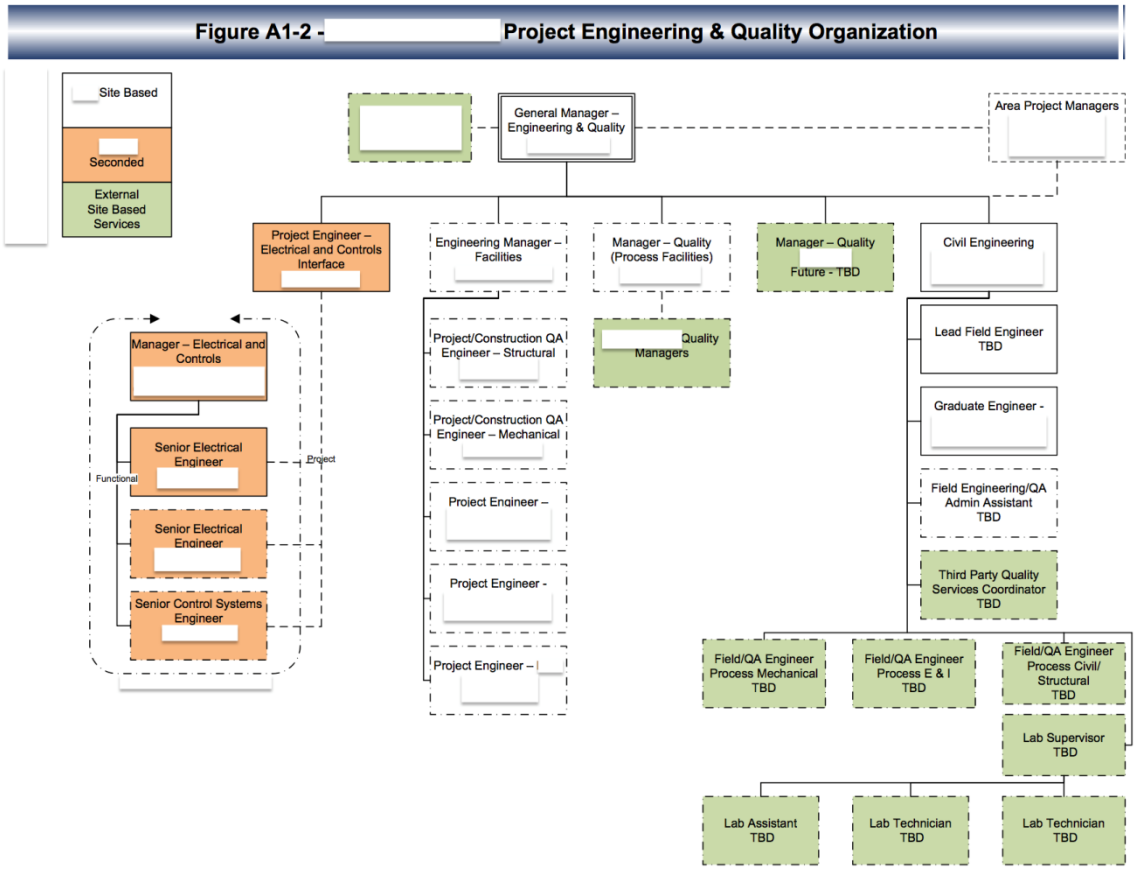

Figure 1: Sample org chart from P1's PMP.

The third interview was conducted with the administration personnel that managed the updates to the PMP. This individual also seemed to be personally invested in the success of the plan and spoke highly of it. However, a main concern about the plan expressed by this individual was simply getting it updated in a timely manner. As with purchasing there were interface points, checks and balances, and procedures involved in updating the PMP. These interfaces created bottlenecks that also stalled the update process. The typically occurred because the project was moving at such a rapid pace that the updates needed to occur at a much quicker pace in order to keep all stakeholders updated.

The final interview was conducted with a permit manager. This individual had many interface points, including some from within the organization and some with external stakeholders. This was one area of the PMP that did seem to be functioning as designed and getting the full benefit of such. Stakeholders outside of the project had the information they needed in order to approve the necessary permits. Additionally, stakeholders inside the project also had the information they needed in order to perform the necessary work. However, it should be noted that this individual had worked for one of the municipalities where permits were procured for this project and thus had relationships already in place that obviously contributed to the success of the project.

Conclusions

Interface management systems have the potential to help effectively manage complex megaprojects in large part because the project is broken down into manageable pieces and the interfaces between different aspects of the project are identified and tracked. Organizational interface management is specifically intended to help define the roles and relationships of all project parties, expectations and lines of communication, and the inter-dependencies that may exist. This paper has briefly described the use of an interface management system on a recent megaproject, and has looked at both the development of the interface management plan as part of the project management plan

and the perceptions of several stakeholders involved in the actual implementation. Overall, it appeared that the stakeholders on this project attempted to closely follow the project management plan. The project management plan itself included a detailed work breakdown structure that identified specific interface points. In general, the interface management plan seemed to be functioning as designed. Key advantages with the setup of this plan included having a dynamic online version available to all stakeholders, training for new stakeholders, and early development of the plan allowed for its effective implementation and had a positive effect on the development of scheduling and budgeting activities. The principal lesson learned from this project was maintaining the flexibility within the document so that it could be modified and updated according to the changing conditions of the project.

Interviewing several of the key stakeholders provided some interesting insight into the actual implementation of the plan. On paper, it appeared that the plan was well thought out and should have been running smoothly. However, the interviews tended to generally identify some places within the plan that had apparent problems. Generally speaking, these flaws appeared to simply be with the execution and performance of the individuals that had interface responsibilities and not with the plan itself. Although a number of "bottlenecks" occurred at certain interface points, it seems that with a little more thought and effort the effects of these apparent chokepoints could be resolved. Another problem that was identified on this project was the need for some sort of project management software solution. Even though there were standardized documents included in the project management plan, there seemed to be a lack of cohesiveness in managing these documents. Finally, the management of the sheer size and complexity of the interfaces could be greatly enhanced with a project management database. This appears to be an area within interface management systems in construction that needs more attention.

References

Chen, Q., Reichard, G, and Beliveau, Y. (2007). "Interface Management – A Facilitator of Lean Construction and Agile Project Management." *Proceedings of the 15th International Group of Lean Construction (IGLC) Conference*. East Lansing, Michigan, July, 2007.

Chua, D. K. H. and Godinot, M. (2006). "Use of a WBS Matrix to Improve Interface Management in Projects." *Journal of Construction Engineering and Management*, 132(1):67-69.

Jung, Y. and Woo, S. (2004). "Flexible Work Breakdown Structure for Integrated Cost and Schedule Control." *Journal of Construction Engineering and Management*, 130(5):616-625.

Pavitt, T.C. and Gibb A.G.F. (2003). "Interface Management within Construction: In Particular, Building Façade." *Journal of Construction Engineering and Management*, 129(1):8-15.

Project Management Institute (2013). "A Guide to the Project Management Body of Knowledge (PMBOK Guide) – Fifth Edition.

Senaratne S. and Ekanayake, S. (2012). "Evaluation of Application of Lean Principles to Precast Concrete Bridge Beam Production Process." *Journal of Architectural Engineering*, 18(2):94-106.

Shokri, S., Safa, M., Haas, C., Haas, R., Maloney, K., and MacGillivray, S. (2012). "Interface Management Model for Mega Capital Projects." *Proceedings of the American Society of Civil Engineers (ASCE) Construction Research Congress 2012, Construction Challenges in a Flat World*. West Lafayette, Indiana, May, 2012.

Siao, F.C. and Lin, Y.C. (2012). "Enhancing Construction Interface Management Using Multilevel Interface Matrix Approach". *Journal of Civil Engineering and Management*, 18(1):133-144.

Wren, D. A. (1967). "Interface and Interorganisation Coordination." *The Academy of Management Journal*, 10(1):69-81.