4th Construction Specialty Conference
4e Conférence spécialisée sur la construction

Montréal, Québec
May 29 to June 1, 2013 / *29 mai au 1 juin 2013*

The Port Mann Highway 1Project – A Case Study on Linking Organizational Charts & Schedule Conflicts

M. A Shamloo[1], K. Hewage[2], A. D. Russell[3]
[1]MASC Student, Department of Civil Engineering, University of British Columbia - Okanagan
[2]Assistant Professor, Department of Civil Engineering, University of British Columbia - Okanagan
[3]Professor & Chair, Department of Civil Engineering, University of British Columbia

Abstract:

In this paper a case study on organizational charts and schedule conflicts in the Port Man Highway 1 extension project (PMH1) is presented. At present the PMH1 project is the largest infrastructure project in North America. The contractor for the project is a General partnership between Peter Kiewit Infrastructure (PKI) and Flatiron Constructors Canada Limited. This project is based on a design-build contract. The cost for this project was initially set to be 2.46 billion dollars, but with having changes initiated and contemplated to date may bring the cost to more than 3 billion dollars by the time of completion. This case study is mainly focused on the first segment of the four segments of this mega infrastructure project.

The case study focuses on the variables that affect milestones in the construction schedule and how the organizational chart can help curb the schedule back on track. Examined is the influence of numerous changes in organizational charts that can effectively change the outcome of meeting schedule requirements. The paper presents insights on how senior management handles unforeseen events in mega construction field environment. In addition, the link between changes in the organizational charts and overall schedule variations are also discussed.

1. Introduction

In traditional transportation project management the three most important aspects of any project have been Schedule, Cost, and Technical or Quality (Marshall & Rousey, 2009). Changing one will definitely change the other two. For example if we decrease cost then the schedule and quality of any project will be changed for the better or for the worst. Project & construction management has the task of efficiently changing these values in a way to maximize the overall outcome of the project.

Traditional project management practice has evolved during the development of the U.S. transportation infrastructure. During this era project management practices were used for projects that are replacing, repairing, and expanding current transportation infrastructure. Traditionally project management was used for tailoring new and upcoming projects. This change itself has changed the practice, due to mitigating a larger risk when it comes to time and cost.

In the recent history public demand is gone toward delivering infrastructure projects more quickly, more focused on time and cost (Sillars, 2009). The demand for quicker and less costly projects has not

changed throughout history, but what has changed is the type of infrastructure projects. Now a day's most infrastructure projects are expanding and repairing current ones. This change will allocate a larger sum on risk, which directly has an impact on time and cost. So it can be safely said that project management in the Port Mann Highway expansion project in general has a new factor added it to it, more risk. This factor can be added to similar projects that been practiced today. This new factor is much different from what was none as risk before. In the past risk was more associated to factors such as resources, labor and budget. But today risk for these types of projects is more associated to factors such as, existing utilities, ground conditions, foot print, public safety, and employee safety. These factors have a significant effect on time and cost, which did not exist in traditional project management in this detail.

This new era of project management has new demand; therefore the traditional project management school of thought needs to curb itself with today's needs. Project management has been evolving into a different entity where the roles and responsibilities of the project manager have expanded beyond the traditional cost, schedule, technical triangle (Atkinson, 1999). Today Project managers of complex projects have to deal with new financing systems and known and unknown constraints.

The focus of this case study on the Port Mann Highway 1 extension project (PMH1) is to obtain data to see how project managers today deal with very complex transportation projects when it comes to schedule conflicts, with emphasis placed on organizational structure of the delivery team. The PMH1 project as a mega infrastructure project has been divided into four different geographical because of project scale. This study focuses on the first of these segments.

2. PMH1 Overview

The existing Port Mann Bridge was built the 1960s, at that time the population of the greater Vancouver area was around 800,000 people; today the traffic crossing the bridge per week is estimated to be around 800,000. The PMH1 project is located between several cities in the lower main land in British Columbia, Canada. The project spans from McGill Street in Vancouver going through the Cities of Burnaby, Coquitlam, Surrey, and ends at 216 Street in Langley for a total length of approximately 37 kilometers (the project scope is illustrated in figure 1). This project is designed to address the growing congestion of the highway, and improve and ease the flow of traffic in the Greater Vancouver region. The project seeks improvements in transit, roads, bridges, drainage, and environmental habitats. The project also includes the construction of a new 10-lane bridge which replaces the, the old Port Mann bridge.

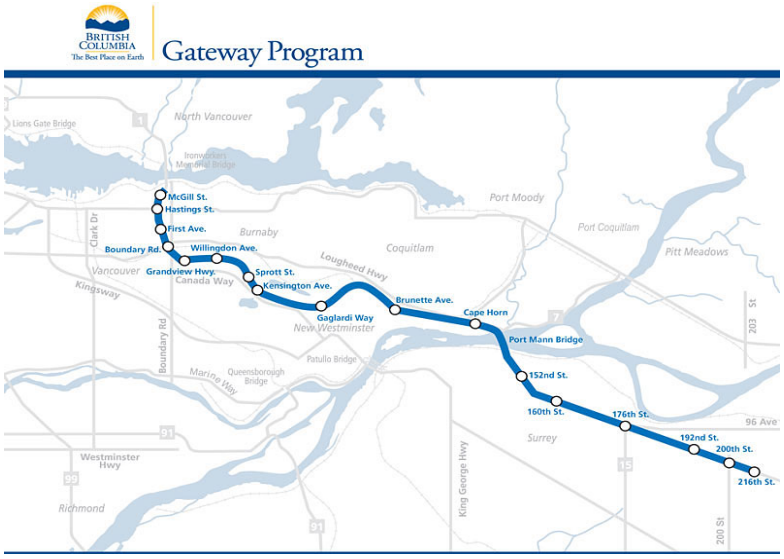

Figure 1 - PMH1 geographical scope

2.1. PMH1 Contractors

This project is being implemented by Transportation Investment Corporation (TI Corp), which is a public crown corporation. The responsibility of TI Corp is to oversee the building of the project and the collection of tolls to recoup projects costs. The main contractor that has entered into a contract with TI Corp is Kiewit/Flatiron General Partnership. Trans/Canada Flow Tolling Inc. (TC Flow) is the toll operator.

The PMH1 project is based on a design-build contract with Kiewit/Flatiron General Partnership. Kiewit Infrastructure is amongst companies under Peter Kiewit & Sons (PKS) Corporation. PKS was first established in British Columbia in the 1940s, and has been a leading construction contractor and has earned a reputation as a leading contractor in Canada. The last mega infrastructure project that KPS worked on was the Sea to Sky project which was completed before 2010 for the Vancouver winter Olympics. Flatiron is a division and a subsidiary of Hochtief which is also a leading construction contractor in the continent. TC Flow will be responsible for the tolling operations. TC Flow is a consortium of Egis Projects and Sanef. This consortium combines the joint strength of global tolling expertise which is being applied already on the Golden Ears Bridge.

2.2. Snap Shot of PMH1

Select features of the project include:

- Widening of HWY1: One additional lane added in each direction plus an HOV lane

- Upgrading Interchanges: Seven Highway 1 overpasses are being widened, Nine Highway 1 interchanges are being replaced

- New special purpose ramps at five locations: More HOV lanes at ramps, Transit only ramps, truck only raps,

- New Port Mann Bridge: A new 10-lane bridge; with a capacity of five lanes of traffic in each direction (including one HOV lane) and the ability to accommodate light rail rapid transit in the future.

- Cycling and pedestrian access: Cycling and pedestrian measures will be incorporated into all new structures where they connect to existing or planned infrastructure.

- Transportation improvements: Congestion-reduction measures ex: expanded high occupancy vehicle lanes; Transit and commercial vehicle priority measures; Improvements to the cycling network

- Environmental improvements: These environmental projects will address four key objectives: enhancement, compensation, construction timing and protection/restoration.

3. Study Objective & Scope

The objective of this case study is to identify actions taken by management including organizational changes taken to help place the project back on track when unforeseen events interrupt the schedule of the project. The main area of interest is to identify those solutions that effect the organizational chart of management and staff. The interest of this case study is to see when and how often senior project management change the organizational chart, how do these changes help with schedule delays and conflicts, and at what levels are these changes made. Also of interest is how the delays and conflicts are conveyed to senior project management, and how long it takes for such information to travel from the field level to senior management level.

The scope of work in the first segment treated in this case study includes, widening the existing highway, constructing several new overpasses and expanding old ones, building new on and off ramps, rehabilitations, and rehabilitating existing structures.

4. Data Collection Procedure

Data collected for this case study was obtained by being present onsite, through interviews with management personnel, and being part of several meetings. The interviews were intended to increase the understanding of problems that different levels of management have to address and how they are resolved, as well to account for variables that impact schedule performance. Some of these variables are well known and are general to all transportation projects for example weather and availability of, resources. Of particular interest was identifying variables in the form of initially unknown constraints for the PMH1 project, but which may also be applicable to other large scale transportation projects. Also examined was the flow of information in order to engage its effectiveness and how it could be improved.

The staff working on segment one was divided into three levels, based on management seniority and responsibility. The reasoning behind dividing the management into three levels was based on the structure that was already built in the project; hence it made it logically easier to understand the organizational chart that was implemented in the project.

Tier or level one contained management personnel charged with managing more than five engineers whose responsibilities were within one department (e.g. earth works, drainage, lighting, structures, etc.) and which involved scheduling and costs. This management level had more oversight on the disciplines schedule. This tier was aware of the day-to-day completion of scheduled tasks, and had closer communication with the field engineers.

The second tier was management personnel responsible for more than ten engineers all of whom were in a single department. These managers were mostly involved with the first level managers and the superintendents. Second level managers were also responsible for a geographical section of the project, the intention being to help oversee milestones and major conflicts. Information regarding work progress and schedule was obtained through meetings and one-on-one discussions with level one managers and superintendents.

The third tier was for the project and construction managers of the project responsible for all work within a specific segment. Tier one managers communicated and reported to the second tier of management. They would inform them of daily issues and what seemed problematic. Tier two managers would discuss the upcoming problems within the second tier management team. If any problems in terms of schedule, resources, labor needs and help was required it would initially be resolved within this tier of management. If the problems were not resolved the next step was to hold meeting amongst the second tier and third tier of management to come to a solution. The division of management staff into three different levels helped with identifying the flow of information and the levels where specific events / problems were addressed.

Interviews were held with individuals at all three levels both general and specific questions were posed. In total 13 interviews were completed. The questions posed were focused on determining how problems escalate from the field to the project office and forward.

5. Discussion of Results

The interview results mainly suggest that the main factor in having delays can be concluded from the lack of communication and resources. Lack in communication can result from over tasking resources which would result in not having high quality communication. It is important to have high quality communication in projects that have very complex critical paths that are constrained by many variables that can affect the overall schedule. In this segment the decision to change the organizational chart to allow for more supervision over the schedule was made to help with the lack of communication.

Also the second factor that has effects on the schedule is resources (mainly labour force). Senior management brought up the issue of not having an experienced labour force. The majority of the labour force working on the PMH1 project is young and the age difference between the experienced and the inexperienced is quite large. The experienced labour force is close to the age of retirement, and it seems that this gap can be an industry problem. Not having a fully-fledged experienced working force has an effect on the schedule. Many training classes are in place to keep the craft force up to date. This learning curb will also slow down production. Safety policies that are being practiced in the project also require constant training. Factors such as safety, inexperience, and the age gap between experienced and inexperienced labour force have an effect on the overall schedule.

The interview results also suggest that second level changes in the organization chart have the most effect in terms of bringing production back on schedule. The second level of management has direct contact with the field superintendents who are running the production in the field. The communication between this level and the field makes the difference in resolving the majority of problems that can affect the production rate and schedule. Making the right changes in the organizational chart regarding this level of management can significantly change the course of production.

The results from the interviews regarding the main variables and factors that effect on the schedule are presented in tables 1 through 3 for the three management levels, ranked in order of importance.

Table 1 - Level one management interview results

Level One Management	
Variables	**Most Effect on Schedule (%)**
Communication	**67%**
Permits	**67%**
Weather	50%
Third Party	33%
Resources	33%
Suppliers	33%

In table 1 it can be seen that most level 1 managers cited communication and obtaining permits as the most important factors contributing to schedule delays. In the interviews most managers stated that there was inadequate communication when it came to the importance of some activities compared to others. The schedule might show a positive float for both activities in question but there should be a logical flow of work, prioritizing each activity. The second most important, obtaining permits from utility owners and municipalities, caused difficulties because of the long periods of time involved, which would delay the schedule.

Table 2 - Level two management interview results

Level Two Management	
Variables	**Most Effect on Schedule (%)**
Communication	**80%**
Resources	**80%**
Third Party	60%
Weather	20%
Permits	20%
Suppliers	20%

Observed from Table 2, communication and resources were identified as the most significant factors contributing to schedule delay by level 2 managers. More specifically, those interviewed brought up the issue of communication between disciplines and prioritizing work in the same area. For example having drainage and electrical working in the same location was quite impossible at times due to both disciplines needing to excavate and thus occupy space. Work space is one of the most challenging constraints to deal with according to most managers. Working on a highway that has live traffic on it twenty four hours a day seven days a week poses significant challenges. Space conflicts results in one discipline waiting while the other completes its task, which causes delays.

Resources are quite hard to obtain as well according to most level 2 managers. Finding an experienced labour force is difficult which poses a great challenge. Safety concerns from senior management require constant craft training due to not having the proper experience. Not having an experienced labour force also delays schedule, due to making tasks take longer than they would under circumstances were the labour force is experienced.

One more factor that was brought up was third parties. Level one management brought up obtaining permits and the second level of management finds having third parties meet the projects schedule is hard at times and has caused delay to the schedule. Third parties that are involved in the PMH1 project are such as sub-contractors, suppliers, utility owners, and municipalities. Sub-contractors that won't follow the safety policies adopted in this project delay schedule due to job shut downs. Training sub-contractors to meet all requirements of safety policies also has caused delays. The need to move certain utilities due to conflicts with new highway design and new structures have been challenging. The main challenge is having everyone involved commit to the schedule proposed and allocating certain tasks as high priority. Getting permits of construction from municipalities takes time and will cause delay. Lane closures, the time allocated for lane closures will effect production rate and delay the schedule. For example constructing a new on ramp can be done in a much shorter time if there is a full closure rather than having a eight hour lane closure for two weeks. Obtaining permits which can help the contractor speed up production can be difficult at times.

Table 3 - Level three management interview results

Level Three Management	
Variables	**Most Effect on Schedule (%)**
Communication	**100%**
Resources	**100%**
Permits	50%
Third Party	50%
Weather	0%
Suppliers	0%

Level 3 managers shared the same view as level 2 managers in terms of the top 2 contributors to schedule delay. They indicated that relaying information down to the first level of management and making changes in the ground was often challenging. Having superintendents focus on areas that are critical to the schedule at times can be difficult due to conflicts with other disciplines. Again the issue of space and having enough work opened up to occupy the labour force for each discipline was hard at times.

Not having a skilled labour force made it difficult to keep every discipline occupied. Training the labour force in more than one trade is key due to the possibility of shifting focus from one area to another. Having a rounded and experienced labour force would allow for swapping manpower from one discipline to another in time of need.

Presented in table 4 is the combined view of all those interviewed. Communication and resources were dominant factors in the minds of most personnel. These two factors have the most effect on causing delay to the overall schedule.

Table 4 - All levels of management interviews combined (thirteen candidates in total)

All Levels of Management	
Variables	**Most Effect on Schedule (%)**
Communication	**77%**
Resources	**62%**
Permits	46%
Third Party	46%
Weather	38%
Suppliers	23%

The solution pursued to address communication issues was adding positions to the organizational chart to help the flow of information between department heads and all engineers. One factor that was brought up in the interviews was having the schedule updated daily rather than the monthly updates to help identify lagging work. The project management team, made the decision of changing the organizational chart. Placing a senior manager level employee to handle schedule conflicts and to come up with a strategy to be able to see in much more detail what's happening when it came to work progress.

The segment was divided into sections each one having significance in comparison to the critical path of the overall schedule. Each section was under the supervision of a senior and intermediate manager. This helped with identifying underlining causes to conflicts. Section managers would have better communication with field superintendents and level 1 and 2 managers. The intention of this change in the organizational chart was to have senior managers communicating the information and to be able to identify areas of problem quicker.

Senior management decided to change the monthly schedule update to a weekly update. Every week disciplines updated their schedules and section managers would review the work flow. This helped observe what can delay schedule. Having the schedule updated weekly allowed for the identification of delays earlier. This identification allowed for quicker action in resolving the matter.

6. Conclusion

The final results from this case study indicates that the main challenge in meeting schedule obligations in mega infrastructure projects like the Port Mann Highway 1 extension are mainly due to communication and resources. From the interview results 77% of the management team identified communication as the sole challenge. 62% of the management team also identified resources as a main challenge.

One might think that the complexity of the project, working along live traffic, constructing many complex detours, working with many third parties, and or obtaining supplies in a timely manner would be the main cause for delays, but from the interviews and research done on this case study it has been proven that communication and resources are the two factors that can cause delays to schedules. Communication challenges can be one factor that exists in any project. The solution to this lack in communication in the Port Mann Highway extension project was by a change in the organizational chart and promoting a senior manager to identify delay causing effects prior to making significant changes to the overall schedule. Adopting a different method to communicate production and schedule conflicts between the personnel.

The main area of interest in this case study was to see how the project management team can solve schedule based problems by changing the organizational chart. Having the opportunity to observe these

changes during the past year and interview the management team it is observed that modifying the organizational chart can have significant results when applied correctly.

Acknowledgments

The senior author would like to take this opportunity to acknowledge the cooperation and help from Kiewit and Flatiron general partnership, especially the project management team. Thanks to the project manager Chris Dandurand for allowing his team to be interviewed and observed to see how challenges are overcome.

References

Atkinson, R. (1999). "Project management: Cost, time, and Quality, two best guesses and a phenomenon, its time to accept other success criteria," International Journal of Project Management, 17(6), December, pp. 337-342.

Marshall, K. R. and Rousey, S. (2009). Guidance for Transportation Project management, NCHRP Web-Only Document 139, Transportation Research board, national Academies, Washington, D.C, 217 pp.

Sillars, D.N (2009). "Development of Decision Model for Selection of Appropriate Timely Delivery Techniques for Highway Projects," Transportation Research Record 2098, pp. 18-28.

Harvey Maylor (2001). "Beyond the Gantt Chart: Project Management Moving on" European Management Journal Vol. 10, No.1, pp. 92-100, 2001

Christof Baitsch and Frank Heideloff (1997). "Collective construction changes organizational reality-An illustration of the relative influence of both consultants and organizations" Journal of Organizational Change Management, Vol. 10 No. 3, 1997, pp. 217-234 MCB University Press, 0953-4814.

Port Mann/Highway 1 – Improvement Project "http://www.pmh1project.com/Pages/default.aspx"