Prospectus

Predicting and Preventing Construction Delays for Hourigan

(Technical Topic)

Actor-Network Theory and Analysis of Delay Causation of Boston's Big Dig

(STS Topic)

By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Sociotechnical Problem

Construction projects of all kinds are plagued by inefficiencies, leading to delays and cost overruns. These inefficiencies can be caused by the project owner, the general contractor, or any number of subcontractors, as well as by outside forces. Project cost is a vital component in the construction industry, and because time is directly linked to money, delay events have an enormous impact on not only the project's planned completion date but also the final cost (Arcuri & Hildreth, 2007). Construction delays can even lead to legal disputes over liability for damages due to delay events, levying heavy sums in compensation from one party to another (Braimah & Ndekugri, 2009). The overarching effect of construction delays and cost escalations is a decrease in project earnings, which is never the goal of any construction project and poses a threat to the viability of a project and the financial stability of owners or contractors.

To address this problem, I will develop a manual with visuals and procedures to reference in real-time while construction is taking place. Hourigan, a general contractor based in Virginia, has provided scheduling data from three of their recently completed medium-sized construction projects which I will analyze in order to produce the manual. The data-driven report will be presented to stakeholders in the company and provide visuals and recommendations that will allow for them to manage, avoid, and overcome future challenges due to delays.

However, relying solely on schedule analytics for delay analysis is to ignore the contribution of social factors such as politics, public opinion, and environmental activism to the schedule and budget of a construction project. These aspects are not present in the current quantitative delay analysis techniques despite their significance to the networks that are construction projects. To explore these issues, I will examine the case of Boston's Big Dig, a construction project that experienced significant time delays and cost overruns. Continuing to omit such factors would present an incomplete and inaccurate picture of the causes of delay, thereby hindering any attempt to predict future delays and resolve claims conflicts, which effectively increases project costs and timeframe.

Because the issue of decreasing delay time to increase project earnings is sociotechnical in nature, it requires a solution that attends to both technical and social aspects. Below I outline a technical process for creating a delay analysis manual involving data-driven recommendations for practices to identify and prevent construction delays during the project itself. Further, I will use the STS framework of actor-network theory and its accompanying concept of translation to analyze the financial and temporal failure of the network of Boston's Big Dig with regard to the network-building elected officials and their interactions with other actors.

Technical Problem

Construction delays are a seemingly unavoidable aspect of any construction project. They cause deviation from a project's as-planned schedule due to various factors, and can be attributed to either the owner, the contractor, or any number of subcontractors. The same root causes of delay can be found among the majority of construction projects, with the most common being changes in scope, mismanagement of resources, misquoted budgets, and poor scheduling.

Several delay analysis methods (DAMs) currently exist to analyze construction delays. They are used after construction is complete to quantify the time and cost effects of the delays, which is necessary for resolving legal conflict (Braimah, 2013). This is done to assess damages to the party responsible for causing certain delays. Engineering and contracting firms do not carry out most delay claims assessments by themselves; outside consultants are typically hired to parse through data and provide a result (Braimah & Ndekugri, 2009). In terms of delay analysis while construction is still occurring, the typical approach in industry is to react to delays using personal experience. Contractors typically cannot foresee delay events and can only react once the event has already occurred. They take the necessary preventative measures to attempt to mitigate the effects of the delay, such as recording design changes and prioritizing critical activities, but this is ultimately based upon a particular contractor's past experience with handling delays in the construction industry (Goss, 2011).

While the formal DAMs can provide sufficient evidence for determining legal liability, they are limited in further usage as they serve only that one purpose. The methods are always applied after construction has already been completed because they require complete project records to guarantee accuracy. Companies also tend to use the simplest, least reliable methods to analyze delay events. This is due to the lack of reliable and adequate project records received by consulting firms. DAMs that produce a more accurate representation of disruption present a number of obstacles to their use, including a high cost of use and lengthy time requirements (Braimah & Ndekugri, 2009). Analyzing and managing delays in-situ with only personal experience as a resource poses a problem with continuity. Each team member brings their own unique experience to the project, and will therefore each react differently to the same delay event.

Relying on the current process for understanding and analyzing delays ensures contractors are not getting a thorough representation of causation. Additionally, analyzing each project after the fact means that information cannot be utilized in real-time as a delay is happening or about to happen. While personal experience and opinion are indeed used during the construction process to deal with delay events, dependence on those sources compromises continuity across different projects and even within the same project.

The solution to this technical problem is to produce a data-driven manual for predicting, handling, and preventing delays that Hourigan can use in real-time during a construction project. A team of three civil engineers and two systems engineers will collaborate to generate this report. This will be accomplished by making predictions and hypotheses based on analysis of scheduling data and records of medium-sized construction projects provided by Hourigan. Scheduling software such as Primavera P6 and Phoenix will be used to view project schedules and apply preliminary analysis using multiple DAMs. Commonalities between delay events will be determined using these software packages as well. This delay management manual will be provided to Hourigan and used on a future project. Feedback from Hourigan will be analyzed to determine its reliability and functionality in a real-world setting.

STS Problem

One of America's most infamous and challenging construction projects is Boston's Central Artery/Tunnel Project. Commonly referred to as the Big Dig, this large-scale "mega-project" aimed to alleviate traffic gridlock by replacing the aging elevated Central Artery highway with an underground highway, as well as two new bridges (Massachusetts Department of Transportation). Construction began in 1991, and though originally planned to be completed in 1998 for $2.8 billion (Bushouse, 2002), the project's actual finish date was in 2007, and the total cost increased by an additional $11.98 billion (Greiman & Warburton, 2009). When accounting for interest on borrowed capital, the final cost is speculated to surpass $24 billion (Moskowitz, 2012). Additionally, a significant portion of this cost escalation can be attributed to inflation due to the considerable delay time of the project. Approximately half of the cost increase can be attributed to inflation for any component whose timeline exceeded a decade (Greiman & Warburton, 2009).

Though the project is heralded as a success in terms of ultimate traffic flow improvements, it is a major failure from a scheduling and budgeting standpoint. Unanticipated site conditions, design changes, and the challenges of working around existing operational infrastructure tend to bear the brunt of the blame (Greiman & Warburton, 2009). While those factors did indeed contribute to the failure of the network, this perspective neglects the involvement of significant network-building actors, the dynamic relationship they possess with other actors, and the social factors they represent. Solely attributing blame to technical factors obfuscates the impact of social factors on the failure of the network such as politics, public opinion, and environmental activism over the course of the decades-long project (Fein, 2011). The consideration of political agendas, community input, and environmentalist values is necessary in order to understand why this network failed.

I argue that the decision-making power of elected officials and the privatization of management as well as pressure from locals and environmentalists caused the financial and temporal failure of the Big Dig. These dynamics between politicians, contractors, the local public, and conservation groups and their potential as rogue actors activated nonhuman actors like public policy and logistical systems within the network, facilitating disruption and ultimate failure. To perform my analysis of the Big Dig, I will employ the science, technology, and society (STS) framework of actor-network theory, which studies the relationships between human and non-human actors and how network builders assemble a network of these actors in order to accomplish a common goal (Cressman, 2009). On a more specific level, I will delve into the idea of translation developed by Michael Callon, which illustrates the formation and maintenance of an actor-network (Callon, 1986). To further support my argument, I will examine evidence from government documents, court records, newspaper reports, and scholarly articles, which provide information about the underperformance of the Big Dig network.

Conclusion

The technical report will provide a data-driven solution to manage, avoid, and overcome construction delays, allowing Hourigan to prevent extended delay time and further delays. This will take the form of an instruction manual for Hourigan to consult while in the midst of a project, and will make recommendations for data-driven practices for the company to utilize. This will provide insight in real time while construction is happening instead of simply attributing blame after completion. The STS research paper will employ the concept of actor-network theory to explore the power dynamics between actors within the network of Boston's Big Dig construction project. Specifically, the failure of the project will be analyzed based on the contributions of political agendas and poor management as well as public and conservationist pressure and their associated actors.

These two reports in conjunction will aim to mitigate the financial and temporal toll caused by construction delays. In the long term, this will improve construction efficiency and thereby increase project earnings. The results of the technical report will offer evidence that data-driven analysis of construction delays constitutes a viable practice for mitigating and preventing delays during the progress of a construction project, decreasing both time spent on the project as well as associated costs. The conclusions of the STS report will serve to reveal the importance of considering interrelated actors and social factors within the network of construction projects when analyzing construction delays and cost escalation.

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