5th International/11th Construction Specialty Conference
5e International/11e Conférence spécialisée sur la construction

Vancouver, British Columbia
June 8 to June 10, 2015 / *8 juin au 10 juin 2015*

CHARACTERIZING COORDINATION IN BOTH LOOSE AND VERY TIGHTLY COUPLED UTILITY RECONSTRUCTION PROCESSES.

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Abstract: Privatization of the utilities sector created a fragmented multi-client, multi-contractor system in which reconstruction works are, in fact, a constellation of multiple smaller projects. During planning stages, these projects are loosely coupled, since stakeholders limitedly align construction plans. Consequently, coordination of unresolved issues moves toward construction stages, creating very tight on-site couplings. This paper focuses on the coordination activities that balance these loose and very tight couplings in the planning and execution stages of utility reconstruction. To this end, we identified seven well-performing 'utility coordinators' and conducted ethnographic interviews to explore their work practices. To better characterize these different practices, we introduce *level of involvement* and *moment of involvement* as two dimensions for coordination within loose and tightly coupled systems. Based on this, we distinguish two dominant approaches for coordination in utility coordination practice: pro-active involvement in early planning stages, and reactive approaches during execution stages. Findings complement to literature by providing dimensions for coordination of loosely coupled systems. Consecutive research efforts should aim at validating these findings and at identifying contextual factors that drive various distinctive coordination approaches.

1 INTRODUCTION

Privatization policies have changed utilities sectors around most of the Western hemisphere. Nowadays, many utility companies own operate and maintain their own subsurface network. Especially in urban space, these networks are often located in the shallow, densely occupied ground. Utility reconstruction processes – defined as the planned activities related to renewal or relocation of utility service networks such as sewage, energy and water pipes, and telecom lines - therefore involve myriads of utility providers. When these companies concurrently re-align or refurbish their infrastructure, each organization is individually responsible for design and construction of its own network. At the same time, they should manage the interfaces with reconstruction work on surrounding utilities and therefore need participation of other utility companies.

In reality, alignment of the various utility companies is difficult for various reasons: First, concurrent utilities reconstructions involve no formal principle client. Instead, all municipalities and utility contractors are clients on their own. They need to collaborate within a shared workspace to reconstruct their own assets. In contrast with ‘common’ construction projects such collaboration cannot be forced through hierarchical coordination mechanisms. Instead, all clients negotiate to decide about design interfaces and

construction methods. A second difficulty for alignment is that clients often hire distinctive contractors to execute reconstruction work. These contractors formally have limited influence on one another's construction plans. Therefore, they mutually adjust plans based on informal improvisation on-site, relying on one another's participation and goodwill.

In short, utility reconstruction comprises of multiple smaller projects – with distinctive clients and contractors. In absence of any mediating or central coordination function, however, organizations often align their construction plans too loosely. Resulting insufficient planning causes interface conflicts. This necessitates troubleshooting and improvisation onsite. Concepts from literature can be used to describe these processes as loosely coupled upfront and very tightly coupled onsite. To address this issue, coordination activities are needed to tighten coordination in planning stages. It is, however, unclear how the activities that balance these couplings can be characterized.

This paper is outlined as follows: To better understand how to loose and tightly couplings in utility projects are managed, the next paragraph explores the activities and behavior of 'utility coordinators'. These 'utility coordinators' are mobilized by utility owners to facilitate collaborative design, planning and execution processes in collaborative reconstruction works. In the research method, we then discuss how we conducted ethnographic interviews with seven coordinators, focusing on their behavior and goals. Outcomes from our qualitative analysis then show that coordination activities differ along dimensions level of involvement and moment of involvement. The paper ends with a discussion and conclusion.

2 THEORETICAL POINTS OF DEPARTURE

The construction industry can be conceptualized as a system of events that are loosely coupled (Dubois and Gadde 2002). Within this system, couplings describe the responsiveness between events. In a loose coupling, mutual relations between events are weak, slow, or infrequent. Loose couplings occur between, for example, individuals, organizations, organizational environments, actions and activities (Weick 1979). These weak couplings allow events to preserve their unique character and create flexibility.

Furthermore, construction industry provides products and systems that are tightly related, i.e. have tight physical couplings. Since these systems have unique and location-centric characteristics and uncertainties, they also need to be coordinated in a tight way. In addition, construction projects often involve a variety of specific trades, contractors and subcontractors (Eccles 1981). These organizations have sequential and reciprocal dependencies (Thompson 1991) that also require tight couplings on the construction project level (Dubois and Gadde 2002). To enhance innovation in construction firms, couplings are also needed between successive construction projects (Dorée and Holmen 2004).

When tight couplings are dealt with in a loose way, however, coordination can become inefficient and erroneous. Similar is shown by Sherman and Keller (2011). They argue that selection of an inappropriate integration mode (i.e. selection of organization structures and means of information processing) decreases coordination performance. One problem in utilities reconstruction is, however that tightly coupled coordination during planning stages is hard to establish. We provide two reasons for this: First, stakeholders may not perceive project-level couplings to be tight. This might be because utility reconstruction works form a constellation of projects comprising of multiple clients and contractors. In this constellation, clients and contractors are not equally committed to streamline project delivery plans. They may even intentionally loosen processes by avoiding making early stage process commitments. This occurs, for example, when clients have different interests with regard to deadlines and use of construction methods. Second, tight integration of project schedules and designs cannot be forced through classical hierarchical coordination. As a result, all clients and contractors individually prepare construction plans. Since they can limitedly influence one another's work planning processes this often results in a loose, slow planning process.

So, instead of having tight couplings, project planning stages seem to consist of loosely related construction plans and stakeholders. Since limited coordination takes place upfront, coordination issues are postponed and resolved in execution stages. This increases coordination pressure on the jobsite managers and work crew. We conceptualize this situation as loosely coupled upfront and very tightly

coupled onsite. We argue that the couplings could be better balanced to obtain a more desired situation. To this end, early planning stage couplings need to be tightened, for example, by increasing stakeholders' early stage involvement and by mobilizing a central coordination mechanism (Table 1).

Table 1 : overview of existing couplings; a more balanced situation of couplings, and their consequences for planning and execution of utility reconstruction works.

	Existing situation	**Consequences**	**More balanced, ideal-type situation**	**Desired Outcome**
Planning stage couplings	Loose	Limited alignment of construction plans, coordination issues postponed to construction site	Tight	Early stage alignment of construction schedules and designs. Interfaces analyzed and potential conflicts anticipated
Execution stage couplings	Very tight	Large focus on troubleshooting and improvisation. Tight deadlines, little buffer	Tight	More efficient coordination, increased flexibility onsite, less pressure on construction processes → overruns less likely

To balance the couplings toward tighter planning stage integration and looser onsite couplings, liaison devices can be used (Mintzberg 1979). The liaison manager, for example, bridges the processes and needs of various clients and contractors. In the utility sector, this important bridging function is executed by a utility coordinator. In the paragraphs below, we explain how we empirically derived dimensions that enable a conceptual description utility coordination. This resulted in two dimensions: level of involvement and moment of involvement.

3 RESEARCH METHOD

To analyze the coordination activities that attempt to tighten loosely coupled planning practices, we conducted ethnographic interviews (Spradley 1979) with utility coordinators. This interview method allows respondents to obtain details and specific about the routines and work practices of respondents. To first identify respondents for our interviews, we searched for representative coordinators that, through years of experience, built up their own work practice to effectively address coordination issues. To this end, we asked service providers and authorities which utility coordinators in their network perform their tasks well. This resulted in a list of seven professionals whose job description relates to coordination of utilities. Their experience varied between two and more than ten years.

As a next step, we conducted the interviews. Two identified coordinators collaborated as a team and were therefore interviewed together; the other five were interviewed separately. The questions in the ethnographic interviews explored the actions, behavior and attitude of the coordinators. We asked the respondents, for example, to describe their common practice, and to elaborate how they deal with unforeseen process disruptions. We collected this data by tape-recording the interviews. We subsequently transcribed the interviews and qualitatively analyzed this data. First, instances of respondents' actions, behavior and attitudes were identified and labeled. Then, we clustered similar codes and created an overview of stakeholders and their correlating actions, behavior and attitudes. The resulting overview allowed us to identify differences and similarities between work practices.

4 FINDINGS

This paragraph elaborates the identified coordination activities. Subsequently, we inductively derive a categorization scheme to conceptually distinguish these activities

From the coordination activities we identified, Table 2 (page 5) summarizes fourteen activities that co-occur in work practices of multiple respondents. Surprisingly, though only three activities were executed by more than three utility coordinators, these are: pursuing utility owners to timely request/issue permits and provide work documentation; being aware of all current plans and decisions, and identifying interfaces between various disciplines. The table shows that most other activities were executed only by two respondents. We provide a few examples of identified coordination activities below (all translated from Dutch).

One respondent motivated his actions and behavior in the quote below. Here he argued that he wanted to play a key role in the reconstruction process. It fits the coordination activity 2 ('being aware of all current plans and decisions') from Table 2:

> *"I find it important to be mobilized by all involved stakeholders. I want to be recognizable. I want to be sure that people know that they can reach me in case they have questions. And I want to be able to answer these questions. In fact, I am a key figure in the whole process."*

An example from another respondent relates to the third coordination activity, 'identifying interfaces between various disciplines':

> *"[we] start with the analysis, which should result in an object-code matrix, which is an overview of all utilities within the project boundaries…and, eventually, we identify conflicts between the design and these utilities. We visualize and code these conflicts on a large map. Then you can see, for example … [that there are] low voltage cables, and telecommunication cables. These are object code X at interface 2"*

Furthermore, regarding the coordination activity 4 in Table 2, 'visiting and monitoring on-site work', another respondent argued:

> *"Well, I always inspect the construction site at the outset of the project. Just as soon as I get an assignment, I will go there to get a grip of how the street, neighborhood or intersection will look like. Because, when one is in a meeting, you need to know where the trees or culverts are."*

Our last quote shows a more exceptional coordination action, number 11 in Table 2: 'verifying accuracy and completeness of utility location information'

> *First, make a good analysis of existing utilities. This creates the basis. Make sure the information and figures are correct. And, as soon as you have any doubt about the location of utilities, check whether the information is correct. This means that one might also need to do a field survey to clarify information".*

Table 2: identified co-occurring coordination activities of respondents, the moment in which they are executed; the level of involvement characterizing the activity, and the amount of respondents employing the activity.

	Activity in work practices of respondents	Moment of Involvmt.	Level of Involvmt.	Nr. of respondents employing the activity
1	Pursuing utility owners to timely request/issue permits and provides work documentation (designs, contracts etc.)	Planning	Pro-active	5
2	Being aware of all current plans and decisions	Planning	Reactive	4
3	Identifying interfaces between various disciplines	Planning		4
4	Visiting and monitoring on-site construction work	Execution	Reactive	3
5	Initiating interdisciplinary meetings with utility owners and contractors	Execution	Pro-active	3
6	Writing minutes	-	Reactive	3
7	Inspecting construction site and utility trench prior to start of the project	Execution	Reactive	3
8	Ensuring constructability of construction plans and checking whether there plans are followed	Execution	Reactive	3
9	Using 'lessons-learnt' from previous projects in existing projects	Planning	Pro-active	3
10	Exchanging information about project progress	Execution	Reactive	3
11	Verifying accuracy and completeness of utility location information	Planning	Pro-active	2
12	Checking whether contractors have a feasible construction schedule	Execution	Pro-active	2
13	Creates an overview and distributes contact details of stakeholder involved	Execution	Reactive	2

Further, we categorized the quotes to inductively derive two distinguishing dimensions for coordination in loosely coupled systems: First, one can characterize coordination work practice based on the coordinator's *moment of involvement* during a reconstruction project's life cycle stage. It seems, for example, that some coordinators are involved during early design and planning stages, while other coordinators participate more actively once construction activities started. Second, the *level of involvement* also varies between various work practices. Our analysis, for example, shows that some coordinators take a pro-active and leading role. They, for example, shape processes and procedures, initiate meetings and take initiatives to aligning parts of the reconstruction plan. Alternatively, other coordinators are more reactive and only interfere with reconstruction processes once holdups or stagnation occurs.

Figure 1 uses our proposed categorization to characterize the coordination activities of our respondents. This shows that there are essentially two approaches to coordinate loosely coupled utility projects: The first one is characterized by pro-active involvement in planning stages. Here, coordination actions focus on shaping design and scheduling processes and actively solving coordination issues. Second, coordination activities can also be more reactive during execution stage. Then, activities mostly involve information processing and follow only agreed formal procedures. It is unclear whether the coordinators deliberately choose to employ one of the two coordination approaches. We suspect that these decisions depend on the coordinator's own coordination style and by procedures that the coordinator's organizations prescribe.

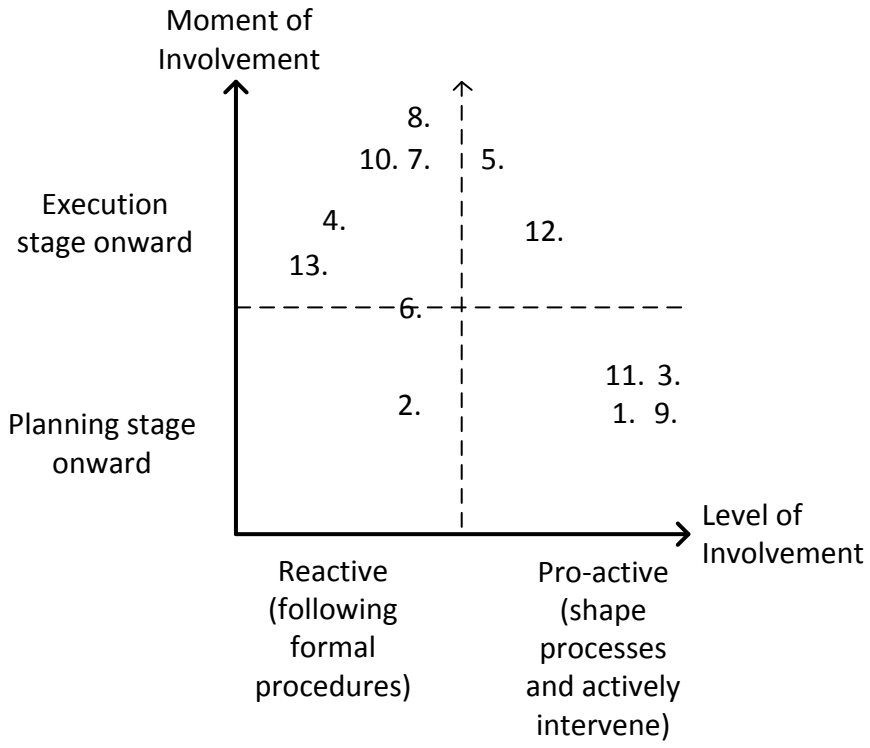

Figure 1 - allocation of coordination activities to manage loosely coupled utility reconstruction processes. The categorization is based on the inductively derived dimensions moment of involvement and level of involvement.

5 DISCUSSION

Utility reconstruction processes are loosely coupled upfront, and very tight on-site. This study identified fourteen activities that are employed to balance the tightness of these two relations. With this, we provide first insight in activities used by coordinators in the domain of utilities reconstruction. We show how liaison roles (Mintzbeg 1979) are mobilized in practice. In the interviews, we found that only three activities were mentioned by multiple utility coordinators, these are: pursuing utility owners to timely request/issue permits and provide work documentation; being aware of all current plans and decisions, and identifying interfaces between various disciplines.

Second, closer investigation of the activities shows that the dimensions moment of involvement and level of involvement characterize the nature of the various coordination functions. The introduced dimensions show which concepts can be used to manage loosely coupled systems. More specifically, two concepts can be distinguished: pro-active involvement from planning stages onward and reactive involvement from execution stage onward. A logical explanation for these two coordination approaches might be that a pro-active involvement in early project stages tightens planning stage couplings. This enhances stakeholders' commitment and supports their collaborative efforts to solve coordination issues. Instead, later involvement during execution stages does not allow coordinators to obtain these benefits any more. Therefore, onsite couplings are likely to be tightened to compensate for loose coordination upfront. Consequently, coordination actions are more reactive, focus on information exchange and contribute marginally to early-stage stakeholder alignment.

For future research, we suggest to expand the sample of our research to obtain more empirical data on the characteristics of coordination practice. Further, findings suggest that the coordination practices are used in different contextual situations. Hence, we propose future research to explore our differentiated

coordination practices more closely. To this end, one could identify environmental and contextual factors that shape coordination practices (e.g. as in Cynefin 2000, Burns & Stalker 1961).

6 CONCLUSION

This study shows that utility reconstruction processes can be characterized as loosely coupled upfront, and very tightly coupled on-site. We explain how the fragmentation of the utility sector created loose couplings in reconstruction planning, while planning ideally demands tighter couplings. This results in coordination issues on-site re-planning, improvisation and overruns. To characterize how coordination in this loose-and-tightly coupled utility system takes place, we investigated the role of liaison managers that guide design and scheduling processes of utility projects. To this end, we identified seven professional utility coordinators. We conducted ethnographic interviews to explore the activities, behavior and goals constituting their work practice. Qualitative analysis shows that coordination activities can be characterized based on two dimensions: moment of involvement and level of involvement. This subsequently allows distinguishing two dominant coordination approaches: pro-active early stage involvement and reactive involvement during execution stages. We propose to conduct future research on how contextual factors drive the use of these two approaches. Finally, findings help practitioners to reconsider and categorize their own practices, and stimulates them to explore how new techniques, tools or methods help to achieve coordination practices.

Acknowledgements

We acknowledge the Pioneering Foundation (Stichting Pioneering) for subsidizing this research. In addition, we greatly thank the respondents for their willingness to participate in this research.

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