

The impact of information sharing misalignment in the Thai construction industry

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Abstract

Conventional construction process of design-bid-build is being used by most multi-national construction companies in Thailand. During detailed design development there are many elements not incorporated into designs, including constructability, often relegated to on-site construction processes by design engineers. There is sometimes misalignment between information needed by design engineers and by construction engineers, both from each other and from other stakeholders such as clients, architects, designers, project managers or suppliers. This problem is not always seen as a management problem in companies because construction management is seen only as a sub-set of an engineer's or an architect's work. This research uses conceptualizations of information sharing theory to identify points where information / knowledge sharing are misaligned and its impact on the building design and construction processes, using multiple case studies of major construction projects in collaboration with construction stakeholders. The research shows that resolving the knowledge/information sharing issue is essential in construction projects to improve quality of built environment design, to minimize design changes, to increase the accuracy of cost estimation and budget control, enable more timely project completion and improve owner and stakeholder's satisfaction. The research will assist Thai construction companies to add value to the construction processes and demonstrate the capabilities of the Thai construction industry that can be transferred elsewhere.

Keywords

Construction information management, information sharing misalignment, information integration

1. Introduction

Information sharing is essential for construction project where there is variety of stakeholders involve in AEC (architecture, engineering and construction) industry. Conventional construction process of design-bid-build requires effective information sharing alignment. This is because each stakeholder has different roles and responsibilities and they require different information from each other in each stage of the construction process to carry out their tasks. Conventional construction processes of design-bid-build and subsequent decision-making are being used by most Thai and multi-national companies in Thailand. Alignment is important to ensure that a project is connected directly to measures of business impact such as quality, cost, or time. Alignment is important as previous research has shown that the alignment of process (construction) and business objectives positively influences the improvement of business performances; and positively influences the contribution of the processes (construction) to the improvement of business performance (McAdam & Bailie 2002; Sun & Hong 2002).

During the both conceptual and detail design stage, there are vast amounts of information from all stakeholders that needed to be combined and transform into a design. This include requirements from

owner which architect need to consolidate with functionality, regulation and aesthetics aspects to put into their design. Then engineers also have to combine owner requirements, architectural design, regulation, material/products information and engineering aspects to accommodate it into their engineering designs. Information that stakeholders need to share and receive from each other is very complex and the AEC industry itself is also a fragmented industry (Rezgui, Hopfe & Vorakulpipat 2010). This makes information sharing even more crucial for construction projects. During conceptual, detailed design development there are many elements that are not incorporated into designs, including constructability. In some cases, there are also requirements changes after bidding is done. AEC practitioners often carry out their own tasks and sometime their information has not been shared in interfaces with other specialists during the detail design stage (Lin 2010). This constructability element is often relegated to on-site construction processes by design engineers and there is sometimes a misalignment between what information design engineers and what construction engineers need from both each other and from other stakeholders such as clients, architects, designers, project managers or suppliers. Common problems that cause by information sharing misalignment in construction include design error, site coordination, mismatched equipment, construction conflict, unsuccessful commissioning, eventually rework and add cost to the projects (Pavitt & Gibb 2003).

This research uses conceptualizations of information sharing theory (Heisig 2009, Pilerot & Limberg 2011) to identify the points where information / knowledge sharing is misaligned and describe its impact on the buildings' design and construction processes. The problem is not always seen as a management problem in companies because construction management is seen only as a sub-set of an engineer's or an architect's training. The key focus of this research is to assist Thai construction companies to add value to the construction processes and demonstrate the capabilities of the Thai AEC industry that can be transferred elsewhere.

2. Research context

Information/knowledge sharing is the process where team members/stakeholders as a group utilize available information (Mesmer-Magnus & DeChurch 2009) to carry out their tasks. Information and knowledge are interconnected. For example, when someone tells what they know (which is their knowledge) to other person, it becomes the other person's information. Information/knowledge sharing includes tasks such as acquiring, creating, using storing and identifying information and knowledge (Heisig 2009). Empirical studies showed that information/knowledge sharing can be considered as a source of innovative thinking which is the vital part for individual improvement and enhance organizational competitive advantage (Bryant 2005; Ford & Staples 2010). The process should also include the act of sharing directions or information to acquire needed information (Pilerot & Limberg 2011). However, how received information can be transformed into knowledge that receivers can utilize is depends on various factors. These include status of the senders, collective judgment and knowledge of the receiver (Widén-Wulff & Davenport 2007).

Research reports a number of common problems in knowledge sharing. These include the level of knowledge between informers and receivers. For example, Ford and Staple (2010) mention that sometimes informers fully share their knowledge while the knowledge receiver has less knowledge on the topic and unable to process the received information, creating an 'information overload' situation. The receivers in the information sharing context have less absorptive capacity for that information. On the other hand, the opposite situation also occur when the informer (with good intention) thinks that to prevent 'information overload' situation, he or she decides to share only partial information and knowledge that will be sufficient for receiver to perform his or her tasks. This also can lead to an information 'withholding' situation (Lilleoere & Hansen 2011). Knowledge sharing can be done in an effective manner if informers and receivers have similar levels of knowledge (both tacit and explicit) or both of them can make sense out of the same context or domain knowledge (Kanjanaabutra 2011).

Another factor that creates information and knowledge sharing problems in the AEC industry relates to poor work processes, especially in conventional construction processes of design-bid-build where there are large numbers of stakeholders involved. Each stakeholder highly protects their own expertise to gain financial reward so they 'try to reveal as little information as possible' (Akintoye & Main 2012) before the contract is awarded, leading to misalignment problems later in the project.

Trust also contributes to successful knowledge sharing for both within and inter-organization context like construction (Lindner & Wald 2011; Nonaka 1994). Trust increases information sharing among stakeholders in construction projects, subsequently enhancing better problem understanding and decision-making (Al Nahyan et al. 2012). This trust relates to trust in terms of the accuracy of the information received, and trust in term of timeliness of the information (Ipe, Raghu & Vinze 2010). In the AEC industry, the timeliness on information sharing can affect the construction process or might cause rescheduling of processes if the receiver is unable to obtain specific information from the informer on time. Information in AEC industry is complex as it comes from various forms and involves multiple stakeholders. Furthermore, the complexity of information also evolves overtime during each stage of the construction process (Peansupap & Walker 2005).

3. Research methodology

This research applied interpretivist approach to analyse collected data. Interpretivist research assume that there is a 'different between the object of natural science and people in that phenomena have different subjective meaning for the actors studied' (Dainty 2008, p. 3). The approach accepts that 'human behaviour is mediated by meaning and seeks to identify types of process and their expression in particular context' (Schweber & Leiringer 2012, p. 484). Therefore, this paper takes an interpretivist approach by means of interpretation of actions and meanings of studied actors (practitioners in Thai AEC industry) according to their own subjective frame of reference (Williams 2000) by using multiple case studies as a means of research methods. Case study research has been defined as a way to 'investigate contemporary phenomena within its real-life context, especially when the boundaries between phenomena and context are not clear evident' (Yin 1994, p. 13). Case studies are also relevant techniques to use to study social phenomena in a single setting to help researchers answer "how" and "why" questions of social situations that involve behaviour through descriptive or exploratory research (Stake 1985). The interview questions were focus on how information has been shared between all stakeholders in construction processes and in establishing what common information sharing problems there are. Semi-structured interviews also allow research participants to express their opinions freely, as well as allowing the researcher to capture new emerging themes which were excluded from theoretical and empirical studies.

3.1 Case studies

This research used semi-structured interview as a data collecting method. The interviews were conducted with 13 practitioners in Thai AEC industry from two case studies of large-scale construction projects in Bangkok. The data were collected from key stakeholders in each construction project. Both construction projects used the design-bid-build procurement method. Detail is shown in Table 1.

Table 1: Case studies details

Case study	Description	Research participants from case study
Case study Project A commencement date 2011	<ul style="list-style-type: none"> • Project A is a high-rise hotel construction project located in Bangkok. • The project application is hotel and service apartment in one building. • The project has been developed by owner who is an international properties developers company. • The architectural conceptual design has been design by international architecture firm and used local architecture firm to carry out detail design. • The project used international design engineering firm. • The project used international contractor company. • The project used design-bid-build contract. 	1 Owner 1 Project manager 1 Architect 1 Engineer 1 Contractor 1 Supplier
Case study Project B commencement date 2010	<ul style="list-style-type: none"> • Project B is a multiple buildings hotel construction project located in Bangkok. • The project application is hotel and service apartment in separated buildings. • The project has been developed by owner who is a local properties developers company. • The architectural conceptual design has been design by international architecture firm. • The project used international design engineering firm. • The project used local contractor company. • The project used design-bid-build contract. 	1 Owner 1 Project manager 1 Hotel operator 1 Engineer 2 Contractors 1 Supplier

3.2 Case studies analysis

The information and knowledge sharing misalignment problems in Thai AEC industry has been utilized through qualitative semi-structured interviews. Both interview notes and transcripts were processed and coded with NVivo computer qualitative data analysis software. The power of NVivo as an analysis tool is in its bringing together strands of data, observations or comments enabling the analysis, the mapping out the concepts involved and establishing the relationships between them. The software used tagging theoretical and empirical studies labels with interview notes and transcript texts and categorizing text into defined themes. Four themes emerged from the coded analysis.

4. Case studies outcomes

Four causes of information and knowledge sharing misalignment problems emerged from the data. These causes were: 1) incomplete construction process structure, 2) inadequate communication channel, 3) disparate stakeholder knowledge, and 4) multiple information formats and are shown in Figure 1.

In the two Thai construction company case studies fragmented and incomplete construction process structure was a cause of information sharing misalignment, resulting in a less than effective construction process. Design-bid-build construction projects always comprise multiple stakeholders. Each stakeholder has their own roles and responsibilities and get involved in the same construction project at different times with different information. “In our company the team who prepared the bidding document is one group and the construction team is another group. Many times they go out and win the bid and get a job without knowledge that the timeline and cost that they bid for are so tight on our construction team, as a result we have to spend a lot of overtime man hours to get the building done” (contractor from case study project A). This informant added that this bidding team had inadequate knowledge of other stakeholders

and did not have the expertise to completely anticipate the information /knowledge inputs of all stakeholders, often leaving ‘holes’ in the information presented in this stage.

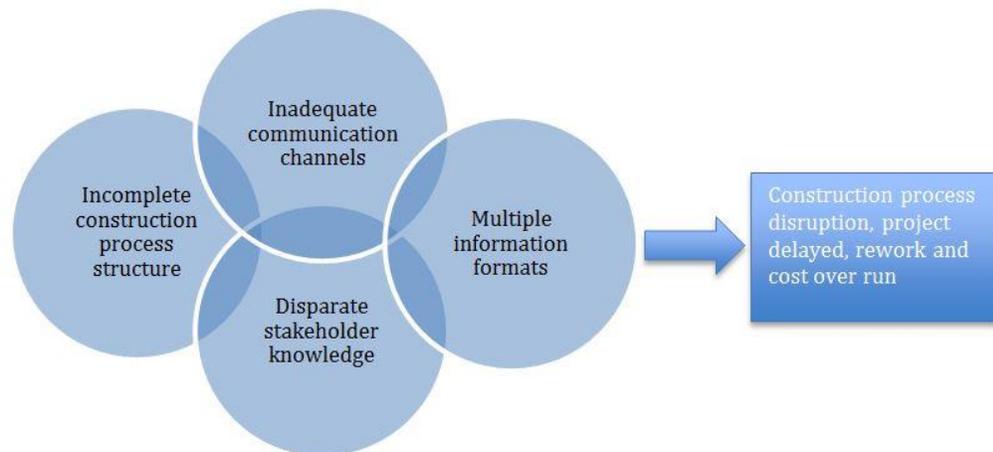


Figure 1 Information and knowledge sharing misalignment causes

In another example a mechanical supplier from case study project B said “In my role as a supplier, we often get involved in the construction project when the design is already finished. There are a number of times that we wonder why the designer selected equipment in the project in that way when we can select other products that suit the construction site better; so we have to put extra effort in preparing ‘Requisition For Approval’ documents with better selected equipment and ask designers to approve it We have to go through documentation channel via the contractor then to the construction manager then to the design engineer which takes a few weeks during the construction period instead of getting things done quicker. It adds to costs through adding time”. The case studies show that when the construction project process structure is not integrated, information misalignment between stakeholders at many points during the construction stage leads to cost overruns, poor time management of the project, and delays in the build.

Inadequate and incomplete communication channel was also another cause of information sharing misalignment in the Thai construction case studies. For example, the contractor from case study A said “during the detailed design process, architects and engineers are often busy with their duties; they often missed out on communication of their tasks and needs. As a result, contractors often found design crashed on site. Sometime we wonder: did the engineers and architects talk to each other during the detail design stage?” The case studies showed there were the inevitable projects delays and cost overruns in the Thai construction projects which were caused by misalignment of information between stakeholders caused simply by a lack of communication at critical points throughout the design/build process.

Stakeholder’s lack of knowledge and expertise also emerged from the data as a cause of information sharing misalignment in the Thai construction project case studies, resulting in less than anticipated project outcomes. For example the engineer from case study project B said: “Some owners break down the building into a number of jobs and call for tenders for sections that they have no expertise in and carry out the design of some of the systems by themselves and then didn’t share information about that system to us. Sometimes we found out later and this forced us to redesign some of our systems. This is because some owners don’t know that the information needed to be integrated in the design process much earlier”. There are a number of informants who mentioned that the other common problem is that project requirements keep changing over time. To carry out redesign to accommodate all these changes sometimes is not suitable for fast track projects. Therefore, stakeholders push design changes during construction and tackle this as a ‘Request Change Order’. This problem sometimes causes on-site

construction process disruption, cost additions and extensions to the project timeliness, affecting project viability and costs. Changing requirements has been shown to result in delays and added costs in construction projects (Love et al. 2002; Love & Li 2000; Sambasivan & Soon 2007). However this research shows that one of the causes of these delays and added costs results from changing requirements results from not just the whims of change by owners and poor design, but also result from a lack of domain knowledge by various stakeholders who assume that they have the expertise. Inadequacy of domain knowledge often leads to poor design, mistakes, need for project changes, added costs etc (Kanjanaabootra 2011).

The multiple formats of information itself was also shown to cause information sharing misalignment in the Thai construction projects, leading to project complications and poorer outcomes than expected. Information in construction projects can come in various forms, formats and in large amounts. These include drawings, booklets, documents, emails, faxes, telephone conversations, in IT formats and meetings. Information processing becomes a vital part for all stakeholders. The owner from case study project A said: "There are a number of times that we have to pay a lot of attention to the making of minute of meetings. Some information from the meetings has been missed out or not properly recorded". This, he added, results in miscommunication, poor planning and mistakes, all of which lead to added costs and time delays. Project managers from both case study projects A and B also mentioned that they have to spend a lot of time to go through their files and emails just to find specific information they needed. These forms of information and knowledge sharing misalignment causes have effected both costs and time in the two construction process projects studied. Chan et al (1997) show that one of the key causes of delays in Hong Kong construction projects is 'slow information flows' resulting in and from complexity and cost additions. Vo-tran and Kanjanabootra (2013) show in an construction project in Australia that even during a very specific process like defect rectification at the project end, multiple forms and formats of information are used and can cause miscommunication and information inequalities that result in misalignment and delays. These Thai construction project cases studies in Thailand have shown that information sharing becomes increasingly complex throughout the construction process from design through build with the multiple stakeholders having differential information needs, different attitudes to information sharing, differential understanding of complexities in the construction process and inadequate understanding of the different forms that information can be used within any single project.

5. Conclusion

This research of two Thai construction projects shows that information and knowledge sharing misalignment is caused by the fragmented characteristics of design-bid-build construction projects, the personal knowledge and experience/inexperience of stakeholders, the nature (forms and formats) of information used in the AEC industry and how all stakeholders work together. The various levels of misalignment that result can cause construction processes to be disrupted, additional costs to be added to projects, time delays, disruptions to project timelines and delays in construction milestones. The research has shown that the problems not only results from inadequate information sharing, but also deliberate misinformation and from inadequate domain knowledge and expertise being used in design and construction decision making.

The studies show that there are possible solutions that can help the Thai AEC industry create better information sharing alignment. For example, the information misalignment caused by the design-bid-build construction process can be overcome with better procurement options that might be more beneficial in some projects such as design and build (or Turnkey in the Thai AEC context) (Akintoye & Main 2012). To tackle information sharing misalignment that is caused by inadequate communications and by the varied nature of information, the Thai AEC industry have to be open and willing to adopt Information Technology (IT) as a supporting tools to enhance their construction process. Available tools include Building Information Modelling (BIM) allows all stakeholders to share information during

detailed design in a more effective way (Chen et al. 2013). Document management systems also can be used to deal with various formats of information and make information traceable (Kang, O'Brien & Mulva 2013). Knowledge management system also a possible tool that can help Thai AEC industry overcome information sharing misalignment that caused by a lack of knowledge and expertise (Dada & Akpadiaha 2012; Vo-Tran & Kanjanabootra 2013).

This research has captured a few examples of information sharing misalignment in the Thai AEC industry from multiple perspectives from all relevant stakeholders. The result reflected a number of problems that everyone commonly encountered. The researcher believes that if the stakeholders understand each other better and acknowledge the problem from a different angle will allow stakeholders in the Thai AEC industry to work with each other in a more harmonious and more effective way. However, the possible solutions need participation of all stakeholders in the Thai AEC industry to work together. The case studies here suggest that this will be problematic but is recognized by stakeholders involved as an issue to be addressed. It requires culture change from all stakeholders. The changes include, more innovative thinking and in looking at AEC industry as a whole.

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