Conflict dynamics in large global infrastructure projects on the basis of institutional theory

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Abstract
This study provides causal models, simulation models and validated policies that are developed after scrutiny of dynamics of conflicts that arose due to entrants' ignorance of local institutional knowledge in large global infrastructure projects. The models illustrate the causative relations of conflict causes due to their propagation, and also the associated cost during the later processes failing to comprehend the local institutional (regulative, normative and cultural-cognitive) knowledge by new coming participants (entrants)in cross-border construction projects.

Key words: Construction conflicts, institutional knowledge, conflict dynamics, system dynamics.

Introduction

Conflict and/or dispute is one of the widely studied topics in the construction industry and it has been widely accepted that the conflicts and/or disputes are inevitable on construction projects(Fenn et al., 1997; Cheung and Chuah, 1999; Pena-Mora and Tamaki, 2001; Jong and Seung, 2003). Conflict encountered in projects lead to prolonged delays in execution, interruptions / suspension of work and sometimes termination of the contract. However, if it is managed appropriately it can be constructive for the project and even add substantial value to the organization (Deutsch, 1994, Kumaraswamy, 1998).

Obviously, there will be participation of various types of participants (actors) within a global project; they commonly arrive armed with a variety of differing institutional logics (Scott, 2012). Actors include both individual actors (persons) and collective actors (organizations). The actors have been classified into two major groups, the host community actorsand new types of players; as proposed by Orr and Scott (2009), the terms ‘host’ and ‘entrants’ are used respectively throughout this article.

The new coming or emerging firms need to understand and attempt to cope with the complexity of the local field level; they must cultivate skills in acquiring and interpreting local institutional knowledge (Javernick- Will, 2009). For the project to be successful, institutional expertise is as important, if not more important, than technical financial or engineering knowledge (Scott, 2012).

In general, the peak of conflicts occurs during the construction stage of life cycle of a project (Pena-Mora, 2002?). The conflicts are usually caused by ambiguous contract documents and are destructive in nature. By contrast, conflicts or arguments that occur in the stages earlier than the construction stage are usually constructive or creative. We argue that the commonly known causes of conflicts that are occurring at the construction phase have their hardwired relation to the project’s basic functions occurred or carried out at the earlier stages prior to the construction stage. If so, the causes of destructive conflicts can be acknowledged and dealt at the earlier stages such as in the planning, detail design, and tendering stage and reduce the level of destructive conflicts at the construction stage. In other words, tracing back the root causes of conflicts, generating the arguments related to them, and dealing with and resolving them at the earlier stages can reduce the conflicts at the execution stage. Further, the arguments generated prior to the construction phase of the project are easier to resolve with less cost and time.

Moreover, the physical uncertainties, limitations of time and physical resources, multi-party involvement, ambiguous contract documents, payment issues, etc. are been accepted as the major causes of construction projects conflict. Further, the involvement of two or more social entities working together for the same goal (project completion) but having different interests, values, beliefs and preferences,also fosters the development of conflict.

However, propagation of conflicts: how they originate and escalate to claims and/or disputes and sometime to the extent of contract termination are yet not well structured. In particular, the conflicts emerging due to entrants’ ignorance of the local institutional knowledge, and their impacts in the overall project performance is also not well studied.

To achieve a better outcome and project success, the foremost necessity is to outline the proximate and root causes of conflicts and determinetheir hardwired causal relationship. Then, the formulation of effective policies and their correct implications is possible and that can be utilized for the efficient management of the conflict as early as possible in the life cycle of the construction project.

Large infrastructure global projects in which there is involvement of at least one foreign company as financier, consultants, and/or contractors have been considered for this study. Projects that experienced severe conflicts during their life cycle, in particular due to the entrants' ignorance of local institutional knowledge will be prioritized for the case study purpose. In Nepal, probably in most developing countries and also in many developed countries, because of limited resources, large infrastructure projects are usually financed by international agencies, constructed by foreign contractors and also designed and supervised by foreign engineering / consulting forms. Moreover, the resources including but not limited to construction material, manpower, and equipment are also need to be imported from other countries. Therefore involvement of 'entrants' in the large infrastructure projects is obvious. Thus, the cases considered in this study are primarily from Nepal. Still, cases presented in this study are from Middle East, Eastern Asia, and Europe as well.

Since conflicts in construction projects are dynamic, complex and nonlinear, they can be described as spiraling between various parties (Ng et al., 2007). To cope with these characteristics of the conflict, two separate methods, inductive (iterative analysis) method and system dynamic modeling (computer simulation) method has been used simultaneously. However, the structured five-stage approach, suggested by Sterman (2000) has been adopted as the principal methodology for this research.

Research Methodology

To represent the realities of dynamic complexities in the origin and escalation of conflicts, and the interaction between conflicts and their management and implementation, a system dynamic simulation modeling technique is adopted in this research. Furthermore, using system dynamics, a model can be developed to simulate the complex and dynamic behavior of conflicts in a construction project through causal loop and stock and flow diagrams.System dynamics is a methodology used to model the key interrelationships in a structure and focuses on the behavioral trends of the main variables of the structure.

The structured, five-stage approach, suggested by Sterman (2000) is adopted as the principal methodology for this research. The approach consists of (1) data acquisition, (2) formalization, (3) systematization, (4) testing, and (5) validation.

For the data acquisition, a comprehensive literature review, case studies, and interviews have been carried out. Firstly, extensive literature review has been carried out to acquire the secondary data. Secondly, face-to-face interviews were conducted with experts, who had been involved in management and construction of the case projects or in the international market. Thirdly, to investigate the real problem, data hasalso been collected from the real cases. To remain in the confined domain of identified variables and also for the more or less consensus answers, a sample questionnaire was prepared for the interview and the same questions were asked of all the interviewees.

A model boundary chart is prepared by categorizing the variables intoendogenous, exogenous and excluded variable. Endogenous variables are those whose interactions are represented within the model. On other hand, exogenous variable are whoseinteractions are not represented in model but assumed. Excluded variable are the variablewhich are excluded from the model scope. The model boundary chart summarized the scope of the model.

Formalization is the beginning of model development process.The collected data is organized into causal loop diagrams to explain the behavior of the system. Causal loop diagram shows how the variables are related to each other. In other words, casual loop diagrams in the model describe conceptual model structure derived from the model developer’s understanding of system and show the dynamics of variables involved in thesystem (Park et al., 2004).A systematic representation has been used to illustrate the interaction and relationship between conflict factors while forming a causal diagram. Causal linkswere established according to Coyle’s (1977) recommendation which is direct observation, reliance on accepted theories,hypotheses, or assumptions, and statistical evidence expert opinion also has been used toestablish the casual relationships among the model variables with the associated variable.

For the systematization, once the casual loop diagram was formulated, a formal simulation model was created. Simulation modelis another version of mental model or casual loop diagram, but written in equations andcomputer code Coyle (1996). In the process of model behavior, computer simulation has been used todetermine how all the variables within the system behave over time. When a model structure is defined the underlyingequations are entered to create the simulation model. The simulation model is then tested for consistency with the purpose on hand and boundary.

Different tests are available for the assessment of dynamic models including the boundary adequacy, structure assessment, dimensional consistency, extreme conditions, and integration errors tests (Sterman, 2000). Themodel is tested for given uncertainty in parameters, initial conditions and modelboundary, sensitivity analysis and system improvement.

Data collected from the real cases is also considered in validating the system.In order to make the model less complicated, it has been divided into several sub models (sectors).

Dynamic hypothesis

A dynamic hypothesis is a working theory of how a problem arose in terms of the underlying feedback and structure of the system (Sterman, 2000). A construction project involves a number of parties with different motives. The number of parties involved varies with the project during its life cycle. A global project is defined as a temporary endeavor where multiple actors seek to optimize outcomes by combining resources from multiple sites, organizations, cultures, and geographies through a combination of contractual, hierarchical, and network-based modes of organization (Orr et. al., 2011, cited in Scott, 2012). If we consider the various types of participants (actors) within a global project, it is clear that they commonly arrive armed with a variety of differing institutional logics.

The conflicts occurring at the construction stage, which are generally destructive in nature, can be reduced by trapping the hardwired relationship of the conflict causes and raising the conflicts at the pre-construction stage. In other words, by amplifying the conflicts at the earlier stage and resolving them the amplitude of conflict effect at the execution stagecan be reduced. Moreover, the conflicts occurring prior to construction phase of the project are easier to resolve with fewer effortsand reducedcost and time. The dynamic hypothesis described above is illustrated graphically in figure 1.

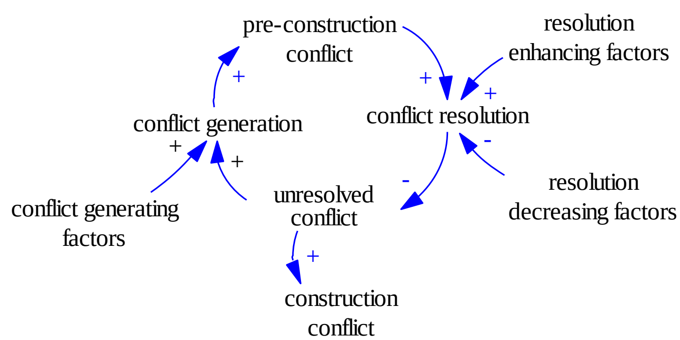

Figure 1, Dynamic hypothesis

The simulation model

The causalloop diagrams were transformed into a simulation model using STELLA 9.1.3 (Figure 2). The main advantage of the simulation software is the ability to modelnonlinear relationships in a user-friendly way. Graphical functions and equations havebeen used to describe the interrelationship of variables. Each variable is assigned with anequation to establish its position and relationship with other variables in the model.

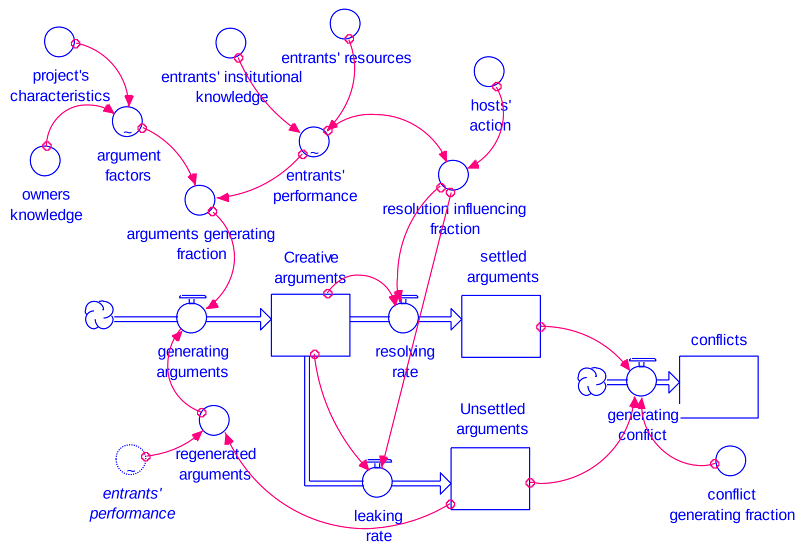

Figure 2, Model of institutional knowledge

Model validation and sensitivity analysis

Model validation is carried out to verify whether a model replicates historical behavior,whether every equation corresponds to a meaningful concept in the real world, whetherevery equation is dimensionally consistent and whether the model is sensitiveenough to analyze policy recommendations (Sterman, 2000). Forrester andSenge (1980) state that there is no single test which serves to validate a systemdynamics model. Therefore,the structural validation, extreme condition, behaviorvalidation, and sensitivity analysis tests werecarried out to validate themodel. These tests are explained below:

- *Structure validation*: causal loop diagram, along with stock and flow diagrams, which are derived from various information sources have been inspected carefully and validated by comparing them with the existing literature reports and through consultation with field experts involved in the construction industry. Subsystem diagrams, flow diagrams and partial model tests were used to assess the structure of the model.

- *Extreme condition test*: the model should behave realistically no matter how extreme the inputs or policies imposed on it. The robustness of the model was tested by applying extreme conditions and the model behavior was observed. Several extreme conditions and combinations of these conditions were tested. For instance, values for institutional knowledge was tested between 0.1, representing the case that the companies involved in pre-construction stages have acquired minimal local institutional knowledge and 1, representing full institutional knowledge. The level of local institutional knowledge acquired by the organization affects both raising argumets and resolving them. The model is found robust because the behavior of the tests is explainable (Figure 3 and 4).

- *Sensitivity analysis*: highly sensitive variables should be considered for policy analysis. Here, the sensitivity of the variable ‘entrants’ institutional knowledge’ is tested keeping other variables value as is. The tested values for scenarios 1 to 5 are 0.1, 0.3, 0.5, 0.7 and 0.9 respectively. The results show that the institutional knowledge acquired by the companies is sensitive (Figure 5 and 6).

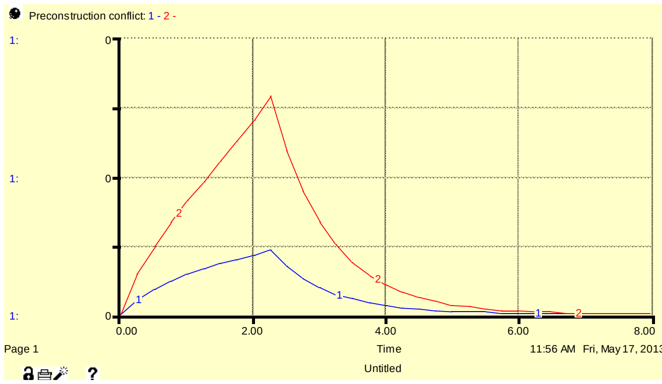

Figure 3 Model behaviors (i. e. preconstruction conflict increases with extreme high valuesof institutional knowledge)

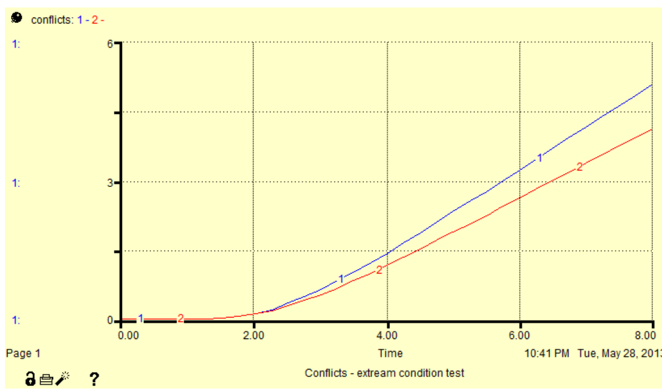

Figure 4 Model behaviors (i.e. construction conflict decreases with extreme high valueof institutional knowledge)

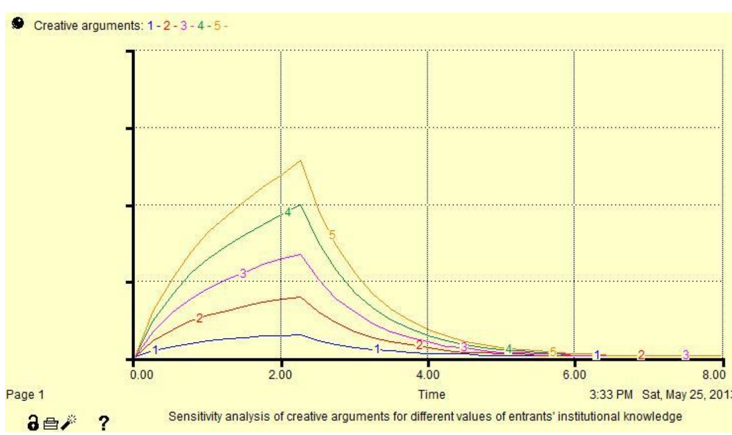

Figure 5 Sensitivity analysis of institutional knowledge (i. e. preconstruction conflict increases with higher values)

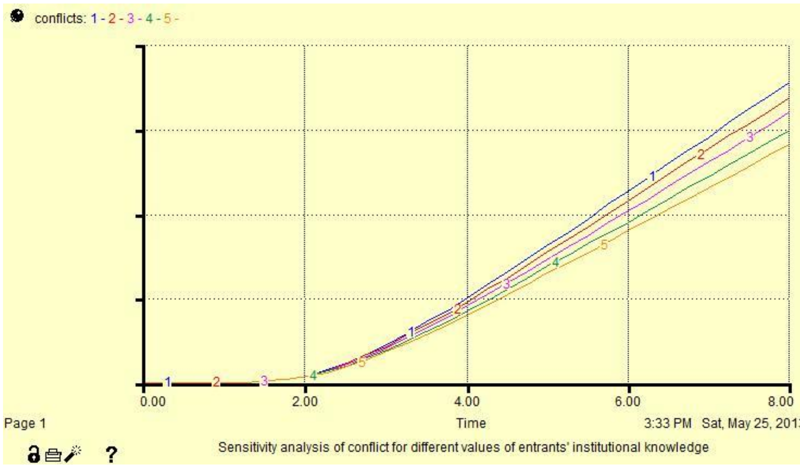

Figure 6 Sensitivity analysis of institutional knowledge (i.e. construction conflict reduces with higher values)

Conclusion

In Nepal, if not globally, conflict is one of the major problems in the construction industry leading to many feasible projects being stopped at the planning stage and also many others being subjected to highlevels of conflicts during the construction stage leading to cost overruns and time delays. Identifying the root causes of conflict that are occurring during the construction stage and settling them as early as possible in the project life cycle is necessary to minimize problems in construction projectsand lead them to success.To address this problem, casual models developed from the qualitative data gathered from the literature, case study of real projects, and expert opinion transferred to a mathematical simulation model. The model is validated through structural,extreme condition and sensitivity analysis tests. Extensive modelexperimentation, validation and sensitivity analysis results indicate that the model isrobust and capable of developing policies by replicating the general behavior of conflict in a construction project.

This study reveals that the causes of destructive conflicts occurring at the construction stage of a projectcould be identified and dealt at the early stages of the projects so that the destructive conflicts that are occurring at the construction phase can be reduced. Further, itemergedthat the system dynamics has high utility as a modeling tool forunderstanding the dynamics of conflicts in construction projects. We believe that the model could be a useful tool for policy makers on large projects.

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