Some of the reasons for large-scale project failures originate from unique organizational features of construction project teams.

Effective communication, coordination, and information-handling processes have turned out to have substantial impacts all the way from the productivity of tasks at the operational level to overall project performance.

A individual or an organization cannot have complete knowledge about complex projects, so that collaborative multi-disciplinary practices among heterogeneous organizations are required in order to accomplish the objectives of projects.

The construction project teams, which are temporally congregated to carry out projects, need to be reengineered all over the life of the projects as they progress.

**OBJECTIVES**

- Identifying the characteristics of construction project teams in large-scale projects from a social network viewpoint
- Contriving measures and methods to assess the collaborative working processes and performance of project teams
- Developing a theoretical framework to explain the impact of collaborative working processes of project teams on project performance
- Developing a computational model to simulate the collaborative working processes of project teams and to predict their performance.

**RESEARCH APPROACHES**

- Collect both qualitative and quantitative data related with collaborative working processes
- Develop a game-theoretical and social network model of collaborative working processes
- Implement a multi-agent-based simulation based on the developed theoretical framework
- Integrate the organizational simulation model with construction process models

**NETWORK MODEL OF COOPERATION**

In addition to the traditional game theory frameworks where focus on how individuals choose strategies as the response of partners’ action choice, how they choose partners in the game (partner choice) is also considered

**BEHAVIORAL DYNAMICS**

- **Players**: Hi\(i=1,...,n\), Strategies: \(S_i = \{Cooperation, Defection\}
- **Network**: \(G(t) = (V(t), E(t))\), \(V(t)\) is accessible, but \(E(t)\) is untraceable
- **Payoff**: \(\Pi_i(g_i) = (a_i + u_i)^{y_i} = a_i + \sum_{g \in S_i} u_{ij}(g_i, g_j)\)

\(a_i\) is the number of partner links in the organization (within relation)
\(u_{ij}\) is the number of relations between organization (between relations)
\(\eta_i\) is the elasticity of \(a_i\) on payoffs with partner link
\(\phi_{ij}\) is the elasticity of \(u_{ij}\) on payoffs
\(c\) is the cost for maintaining a relation (within cost, between cost)

**NETWORK DYNAMICS**

- **Probability of meeting**
  \(P_{ii}(t) = \eta_i \cdot \sum_{k \neq i} P_{ik}(t)\)
- **Familiarity** \(\eta_i\) is depreciated at a rate of 0.01
- **When meeting new individual** \(k\), \(i\) compare payoffs of all possible combinations of relations at \(g_{ik}\), then:
  - if \(u_{ij} < u_{ik}\), then \(\eta_i\) is depreciated at a rate of 0.01
  - elses for \(u_{ij} > u_{ik}\):
    - forms a new relation with \(k\)
    - else if \(u_{ij} > u_{ik}\):
      - forms a new relation with \(j\)

**CONVERGENCE TO STABLE NETWORKS**

Simulation with 100 agents
- Two types of agents: green, red
- Within familiarity: 2/10
- Between cost: 0.3

- Maximum number of relations per agent: 3
- Simulation results and findings:

- Network reaching stable state takes long time due to low between familiarity, 65 rounds on average
- Because maintaining between relations is expensive, individuals prefer having only one between relation
- Individuals achieve the payoff of 1.9328 on average (possible maximum is 2.2998)

**PAYOFF DYNAMICS**

Within familiarity: 50, between cost: 0.2
Within familiarity: 10, between cost: 0.3
Within familiarity: 50, between cost: 0.5

**AVERAGE PAYOFF**

- The less individuals are aware of networks they are involved or they like to make relations with strangers, the longer it takes for networks to reach stable states
- One of possible reasons of birds in a feather in project teams is observed. In particular, when making new relations or maintaining existing relations with the unknown are expensive in terms of time, cost, or efforts, individuals tend to make relations with the known
- When individuals have to pay higher cost to make new relations or to maintain existing relations with the unknown, they end up with attaining suboptimal payoffs by forming more relations within their groups while losing chances to increase payoffs by forming diverse relations

**CONTRIBUTIONS**

- It is expected that this research provides construction managers with explicit ways to consider the impact of organizational issues on project performance in planning phases so that they can develop more realistic plans
- It is also expected that this research helps construction managers to optimize their teams through pre-analytically iterating evaluation processes

**ONGOING AND FUTURE STUDY**

- Elaborate analysis of social networks in project teams of large-scale construction projects
- Development of more sophisticated and natural representations of agents’ cognition and behavior
- Integration the organizational process model with construction process models
- Extension to the entire life span of project management including project monitoring and control phases