A Study on the Dynamics of Software Requirement Volatility, and Strategies for its Management

Abstract

Software requirement volatility relates to the change in requirements (in terms of the number of additions, deletions, and modifications) during project development. It has been identified as one of the significant factors leading to project disasters. Software project progresses under the constant interaction of 'rational' elements that includes developers, customers, users, other organizational elements and the project manager. Software requirement volatility is one behavioural pattern that evolves out of this dynamics, and needs to be effectively managed in order to culminate in a successful endeavour. In this dissertation, we focus on the nature of requirement volatility. This investigation looks into the dynamics of software projects and its interplay with requirements changes. We want to explore the phenomena through a thorough understanding of:

(a) How the drivers of requirement volatility evolve over time?
(b) What is the impact of the process competencies necessary for managing requirement volatility?
(c) What is the impact of user behavior on the dynamics of requirement volatility?
(d) How the magnitude and pattern of requirement volatility affects project performance?

By endogenous modeling of requirement volatility, we expect to formalize a state-information feedback model that links decision making structures in respect of different dimensions (magnitude, timing, propensity and patterns of variation) of requirement volatility. The research culminates into an executable simulation model that represents the software development environment of the traditional waterfall model, and in the process explains the antecedents and consequences of requirement volatility thereby providing guidance on its effective management strategies.

Requirements are found to change in various ways during the course of a project. This can affect the process in widely different manner and extent. Using system dynamics models we study the

effect of four different patterns of requirements variation on software project. One of the models represents waterfall methodology while the other one represents incremental methodology. Result indicates variations in performance metrics like total effort, completion time, and workforce utilization across experimental scenarios as different patterns of requirement volatility impact software project dynamics in different ways. The insights into the relationship between requirement volatility pattern and project performance prompts us to conclude that appropriate management structures can help to control the effect of requirement volatility.

We use empirical study to investigate organizational practices regarding use of management intervention strategies under requirement volatility, and the project characteristics that influence such choices. Results based on eleven interviews and 97 completed survey responses revealed significant appreciation of the threat posed by requirement volatility. A tendency of ad-hoc deployment of management approaches was noticed. Communications with users and other project stakeholders emerged to be the most adopted management approach under requirement volatility. A requirement volatility management efficacy model could be derived which showed predominant usage of reactive management strategies with low contribution to project success thereby highlighting some managerial ineffectiveness under volatility.

In the next part of our investigation, we studied the effect of varying levels of user involvement on software project performance. We noted that the initial involvement of the users as well as the ongoing level of involvement can vary during the course of the project. We use the system dynamics approach wherein a model of user involvement was developed based on literature. Simulation results highlighted some of the undesirable effects on project performance that is caused at higher levels of user involvement. This may not be very apparent to the project managers initially. What-if analysis with the model parameters generates different patterns of requirement volatility. In earlier chapters we have demonstrated the effects of these patterns of requirement volatility. These insights into the relationship among user involvement, projects change order generation, and project outcome prompted the next part of this thesis wherein we looked at drivers and inhibitors of user involvement.

A second empirical study was conducted to arrive at the determinants of user involvement during software project development. Four focus group interviews in the first phase led to the development of a user involvement enabler model, whose validation based on 78 survey

responses highlighted the significant contributors. Perceived project importance and perceived ease of user participation were found to be the primary drivers behind user involvement. The analysis thus illuminated the suitable handles in order to enable a project manager to efficiently control the level of user involvement in the projects.

In the final segment of the research we integrated all the learning into the software project dynamics model representing the waterfall process model. Different management intervention strategies were suitably implemented in order to investigate their efficacies under requirement volatility. Simulation results indicated communications management to be the most effective, emphasizing the need to focus on user integration strategies. This suggests that project management approaches that treat requirement volatility to be an endogenous phenomenon influenced by the project environment perform better compared to the other approaches that treat requirement volatility to be a random phenomena. Overall, we expect that our study would provide useful insights regarding dynamics of requirement volatility, and would lead to designing of effective change management strategies. This in turn would ensure a greater project management success under requirement volatility.