

The effects of change control and management review on software flexibility and project performance

Eric T.G. Wang^a, Pei-Hung Ju^a, James J. Jiang^{b,*}, Gary Klein^c

^a Department of Information Management, National Central University, Chung-Li 32054, Taiwan, ROC

^b Department of Management Information Systems, University of Central Florida, Orlando, FL 32816-1400, United States

^c College of Business and Administration, The University of Colorado at Colorado Springs, 1420 Austin Bluffs Parkway, Colorado Springs, CO 80933-7150, United States

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ABSTRACT

Software flexibility and project efficiency are deemed to be desirable but conflicting goals during software development. We considered the link between project performance, software flexibility, and management interventions. Specially, we examined software flexibility as a mediator between two recommended management control mechanisms (management review and change control) and project performance. The model was empirically evaluated using data collected from 212 project managers in the Project Management Institute. Our results confirmed that the level of control activities during the system development process was a significant facilitator of software flexibility, which, in turn, enhanced project success. A mediator role of software flexibility implied that higher levels of management controls could achieve higher levels of software flexibility and that this was beneficial not only to the maintainability of complex applications but also to project performance.

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1. Introduction

Software projects continue to be plagued by budget overruns and a failure to produce software that meets expectations. Failure to meet cost budgets may adversely impact future resource allocation and failure to meet time considerations may hamper the firm's competitive posture.

Various forms of control have been proposed as solutions. The CMM defines layers of control to help ensure higher quality products and more efficient procedures. Studies have found that such controls improve the development process. In particular, change control to limit scope creep and management review to perform intermediate quality checks on the system have been shown to be effective in improving project performance [15,27].

One indicator of quality software is software flexibility [8]; it allows a product to be modified rapidly and cost-effectively for new needs. However, achieving a high level of software flexibility has often been slow, inflexible, and time-consuming, even with the aid of sophisticated development tools and methodologies [13].

Thus, it seems to oppose the goal of efficient production. Thus, it seemed necessary to examine managerial controls to determine if they can help in implementing higher levels of software flexibility while still managing to meet budgetary restrictions.

We therefore attempted to develop a framework for investigating the effects of two prominent control methods on the conflicting goals of software flexibility and project efficiency and testing the model empirically.

2. Background

Software is flexible if it can be efficiently and rapidly adapted because of a change in business needs. At least, two directions of research have been pursued in achieving software flexibility. One focuses on improving methods of designing software for change [12]. For example, structured or object-oriented design facilitates change by organizing and localizing data processing in an application. The other stream focuses on the evaluation of the impact of software flexibility design efforts on organizations and their software development processes; e.g., Kemerer [17] argued that structured design did not always appear to yield the promised benefits by reducing software maintenance, while Banker et al. [3] found that too much structure could introduce additional complexity, thus complicating software maintenance, and Banker and Slaughter [4] argued that higher levels of software structure were

* Corresponding author. Tel.: +1 407 823 4864; fax: +1 407 823 2389.

E-mail addresses: ewang@mgt.ncu.edu.tw (Eric T.G. Wang),

handel@mgt.ncu.edu.tw (P.-H. Ju), jjjiang@bus.ucf.edu (J.J. Jiang),

gklein@uccs.edu (G. Klein).

advantageous only for complex and volatile applications. Here, flexibility should not be considered from a software engineering perspective but from its impact on the organization [16].

Advocates of software flexibility and software process quality improvement consider the organizational benefits of investment in structured software design to exceed the costs. They show a link between the quality of software products and productivity [18]. Such studies have attempted to identify the potential benefits of software flexibility from a maintenance perspective. Unfortunately, though software flexibility is believed to affect project performance and therefore should be explicitly considered in software design, no empirical study has examined the impact of software flexibility from a project management perspective. Project management typically considers IS project performance in terms of amount and quality of work, and meeting budget and schedule goals [24]. Questions arise: Do project cost objectives conflict with the software flexibility needed after the conclusion of the project? Does a design for flexible software improve performance during the development process?

A number of efforts have been made to understand the effect of managers and IS team members on the system development process, including using control theory [10], factors of coordination [29], and methods in software engineering [22]. What software flexibility typically does not address is the managerial-oriented activities inherent in the system development process. In our study, two management controls were considered as antecedents to software flexibility: change control and management review. The former depends on the extent to which software change control mechanisms are implemented. The latter refers to the extent to which managers are involved in the formal review mechanisms that monitor IS teams behavior leading to the attainment of project goals [21]. Prior research argued that software flexibility was specifically associated with the CMM key process area: project tracking and oversight [1] and change control was chosen because the IS literature has shown that technical success can be best achieved by controlling technical risk [9,26]. In turn, these practices are expected to improve project performance, yielding the model shown in Fig. 1. Change control reduces the need for software flexibility by limiting the risks of project drift. Management review affects both by correcting deviations. The link reflects our hypothesis that flexibility and performance can be simultaneously obtained, with a likelihood that software that can be easily changed will also benefit productivity throughout the project due to changes that arise before development is complete.

2.1. Change control

Change control facilitates software flexibility by controlling risks due to unstable scope and run-away-requirements. Risk management can identify, analyze, and control risks factors and thus result in high quality systems. Run-away-requirements pose a

major threat to software development. Of course, as a system is developed, additional requests arise but this must be controlled or the creeping requirements not only induce other project risks but also lead software teams to aim at a moving target, leading to a lower quality system.

A good relationship with the customer depends on following a rigorous change control process. By denying irrelevant requests and focusing on functional tasks, the approval workflow allows project managers to absorb pressures and prevent the overloading of software teams. Therefore, the teams will identify the core requirements and their potential to change, and proactively engineer flexible capabilities into software components that are volatile [19]. Accordingly, we postulate:

H1a. *Change control mechanisms in IS development will positively influence software flexibility.*

For a large software project, uncontrolled change rapidly leads to chaos, often resulting in delays, overruns, and poor quality with additional time and cost. Once the configuration baseline of a software system is established, any change has to follow a predefined process. This leads to another hypothesis:

H1b. *Change control mechanisms in IS development will positively influence project performance.*

2.2. Management review

Software team members sometimes decide to meet process budgets by ignoring flexibility and maintainability [2]. One way for managers to deal with this is to implement mechanisms through which they monitor and evaluate the flexibility of the systems. Bosch and Lundberg [5] proposed a development processes that incorporated managerial behavior and outcome control: Managers review and audit the behavior of software teams to ensure adherence to the development processes and iteratively perform measurement, assessment, and correction. Then, software developers become conscious of the use of flexibility in highly volatile software applications. Accordingly, we expected:

H2a. *Management review in IS development will positively influence software flexibility.*

Management review facilitates project performance in various ways; they make sure that there are sufficient resources, including skillful people, avoid barriers, and choose appropriate software early in the project development. Furthermore, managers must effectively manage the measurement of progress towards the objectives, monitoring and taking action to eliminate any deviations from desired outcomes and expected behavior. Thus, we expected:

H2b. *Management review in IS development will positively influence project performance.*

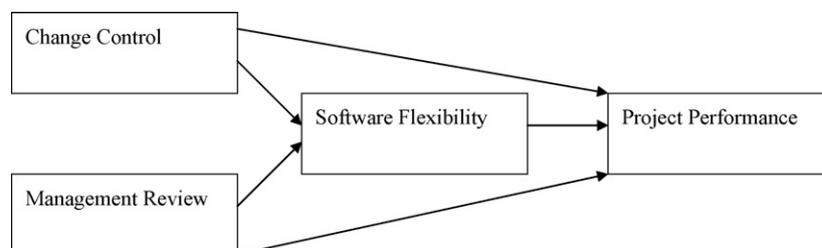


Fig. 1. The research model.

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