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Examining the impacts of organizational culture and top management support of knowledge sharing on the success of software process improvement

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A B S T R A C T

Although numerous studies have discussed the importance of the relationship between knowledge management and software process improvement (SPI), a research gap still exists in relation to how the specific role of knowledge sharing influences successful SPI implementation. This study advances our knowledge by developing an innovative model for exploring the impact of knowledge sharing on SPI success, the impact of knowledge sharing in specific organizational cultures, and how the support of top management specifically influences the path to SPI success. To empirically test the model, this study adopts the statistical technique of partial least squares (PLS) to analyze 118 samples collected from SPI-certified Taiwanese organizations. The results suggest that clan-type organizational culture has a stronger association with knowledge sharing than hierarchy-type in the context of SPI success. SPI knowledge sharing is found to be a mediator of both clan culture and top management support in the context of SPI success. The findings also include the implication to improve our knowledge about how organizational culture and top management support drive effective knowledge sharing on the way to SPI success.

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1. Introduction

The fundamental goals of software process improvement (SPI) are to develop better-quality and more reliable software, to increase customer satisfaction, and to increase returns on investment. SPI may be the dominant approach used by software firms and organizations to improve their competitive market position (Niazi, Babar, & Verner, 2010). SPI was developed in response to the need for managing and improving the quality of software development (Samalikova, Kusters, Trienekens, & Weijters, 2014). Specifically, SPI emphasizes improvements in resolving various issues arising from ad-hoc software processes and aims to obtain optimal solutions for process issues throughout the planning, development, and production cycles, as well as to resolve organizational and management issues. To provide guidance for implementing SPI, a number of theoretical process reference models have been developed, such as the ISO9000 series of standards, the Capability Maturity Model Integration (CMMI), the Quality Improvement

Program (QIP), and the Software Process Improvement and Capability dEtermination (SPICE) process.

As SPI is a highly knowledge-intensive activity (Dyba, 2005; Mathiassen & Pourkomeylian, 2003), the theory of knowledge management (Alavi, Kayworth, & Leidner, 2005; Alavi & Leidner, 2001; Baskerville & Dulipovici, 2006; Schultze & Leidner, 2002) is used as the theoretical base of this study. Knowledge management regards knowledge as the foundation of a firm's performance (Small & Sage, 2005). Knowledge management is the process of acquiring, storing, sharing, creating, and using knowledge (Nonaka, Toyama, & Konno, 2000). In the SPI context, the improvement of software processes involves intensive teamwork and produces significant amounts of knowledge, making the effective sharing of knowledge among individuals essential (Slaughter & Kirsch, 2006). In the process of software development, knowledge sharing helps to avoid the same mistakes, reducing dependency on a few employees who own critical knowledge, increasing integration of individual competencies (including knowledge, experiences, and skills), and improving decision-making (Meehan & Richardson, 2002). Through sharing, employees can effectively increase their understanding of identifying and fulfilling potential improvement

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needs of the processes for achieving ad-hoc SPI goals and increasing the overall performance (Rus & Lindvall, 2002).

In previous studies, the contribution of knowledge management to the effective execution of software processes and to the increase of employees' competencies and skills related to software development has been described (Feher & Gabor, 2006; Meehan & Richardson, 2002; Rus & Lindvall, 2002). However, these studies were mostly case-based observations of individual firms. There is currently no significant empirical and quantitative evidence for understanding comprehensively the impact of knowledge management practices on the implementation of SPI and on SPI success. Therefore, in this study, we attempt further examination of how knowledge sharing influences SPI success. Moreover, according to knowledge-management literature, two organizational antecedents—organizational culture and top management support—may critically determine employees' knowledge-sharing activities (Jones, Cline, & Ryan, 2006; Lin, 2007b). From previous SPI studies, little is known about how organizational culture and top management support may affect knowledge sharing in the context of SPI success.

Organizational culture is considered to be a significant environmental factor in SPI implementation (Muller, Kraemmergaard, & Mathiassen, 2009; Muller & Nielsen, 2013; Ngwenyama & Nielsen, 2003; Niazi et al., 2010; Passo et al., 2012; Shih & Huang, 2010). Organizational culture influences the way in which employees think, act, and respond to process improvement missions (Passos, Dias-Neto, & da Silva Barreto, 2012b). Hyde and Wilson (2004) stated that organization culture affects the extent of collaboration of the SPI among employees while the work of improvement is being carried out. In addition, culture influences employees' willingness and behavior in terms of knowledge sharing: cultural effects may encourage or impede employees' knowledge-sharing activities (De Long & Fahey, 2000; Jones et al., 2006). Shih and Huang (2010) argued that the significant effect of organizational culture on SPI makes it necessary to investigate how culture influences the development of knowledge during SPI implementation. Nevertheless, there has as yet been no study investigating the impact of organizational culture on knowledge sharing in the SPI context. Therefore, in this study, we investigate how culture can encourage employees to participate in knowledge sharing that may be critical to SPI success.

Another factor that could exert a significant influence on SPI success is more individualized. Top management may be an individual or a small group of critical individuals who influence employees' perceptions and willingness to engage in tasks. Top management support has been demonstrated to promote the success of technological implementations (Jones & Price, 2004; Jones et al., 2006; Shao, Feng, & Liu, 2012). However, the current SPI literature does not empirically address the mechanisms by which top management support facilitates knowledge sharing in relationship to SPI success, and thereby how it helps to sustain the success of SPI (Dyba, 2005; Niazi, Wilson, & Zowghi, 2006; Rainer & Hall, 2002; Sulayman, Urquhart, Mendes, & Seidel, 2012; Wilson, Hall, & Baddoo, 2001). Previous knowledge-management studies have documented how supportive behavior by top management is essential to nurture a conducive climate and workplace in which employees are encouraged to apply their knowledge in their work. Moreover, top management support enhances the level and quality of knowledge sharing and exchange through influencing employee commitment (Wang & Noe, 2010). Top management support with proper employee incentive mechanisms facilitates knowledge sharing and stimulates employees to share their knowledge, which in turn may contribute to organizational success. In the SPI context, where there is a high demand for knowledge sharing, top management support may also affect knowledge sharing through their

influence on the norms and climate of the employees' workplaces. Therefore, in this study, we examine the relationships among top management support, knowledge sharing, and SPI success.

Based on the background knowledge described above, several research questions are addressed in this study. (1) What is the relationship between knowledge sharing and SPI success? (2) Which aspects of organizational culture are most important in terms of SPI knowledge sharing? (3) Does top management support influence and facilitate SPI knowledge sharing and SPI success? To answer these questions, this study proposes a research model that adopts the statistical technique of partial least squares (PLS) and uses samples collected from SPI-certified Taiwanese organizations to model the relationships among organizational culture, top management support, SPI knowledge sharing, and SPI success. When collecting our sample, we focused on a specific SPI program, which is capability maturity model integration (CMMI) (SEI, 2010). By addressing the proposed research questions, from the theoretical aspect, this study not only contributes to the extant SPI literature regarding the role of knowledge sharing in SPI success but also extends the understanding of how specific organizational culture and top management support can influence the way to SPI success. From the practical aspect, this study offers information to the discussion on how, by combining knowledge management and software process management, as well as how digital tools may help foster knowledge sharing and build a knowledge-oriented culture within an organization in the context of SPI.

The paper is organized as follows. Section 2 reviews relevant research to show the foundations for the hypotheses and the research model. Section 3 describes the methodology. Section 4 presents the statistical analyses. Section 5 discusses the findings and implications. Section 6 describes the limitations of the study and outlines directions for future studies.

2. Research model and hypotheses development

The research model was developed to enable consideration of the relationships among organizational culture types, top management support, SPI knowledge sharing, and SPI success, as shown in Fig. 1. The organizational culture types used in this study are those that were defined in the competing values framework (CVF) (Cameron & Quinn, 2006).

The theoretical basis of the model was developed by reviewing and surveying the literature. The literature that suggests relationships among organizational culture types, top management support, SPI knowledge sharing, and SPI success is described in the following sections.

2.1. SPI success

SPI has been proven to provide benefits for firms. It can improve product quality, shorten the time to get products to market, increase productivity, reduce costs, and more. To realize these benefits, the effective implementation of SPI requires time, careful scheduling, resources, and knowledge (Mathiassen & Pourkomeylian, 2003; Meehan & Richardson, 2002; Niazi et al., 2006). Decisions about SPI implementation are influenced by organizational factors, and several studies have analyzed the critical success factors involved in SPI success (Dyba, 2005; Montoni & Rocha, 2007; Niazi et al., 2006; Rainer & Hall, 2002; Sulayman, Mendes, Urquhart, Riaz, & Tempero, 2014; Sulayman et al., 2012; Wilson et al., 2001).

Dyba (2005) validated a theoretical model of SPI success factors and proposed an operational definition of the variables of SPI success. The study suggested that SPI success is defined by two indicators: improved organizational performance and the