

UDC 331

**EXPLORING THE CONTROL EFFECTS IN THE SOFTWARE OUTSOURCING:
UNIFYING THE ROLE OF CONTROL WITH KNOWLEDGE AND REQUIREMENTS
VOLATILITY**

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ABSTRACT

With the widespread of software development outsourcing (SDO) for modern organizations, control has become an important tool for performance enhancement. Control is usually referred to an outsourcing client's control activities of development vendors to ensure that an outsourcing project meet the project goals encompassing process and software performance. Despite the importance of control in SDO projects, there is little research on how to improve the impact of control on project performance. In addition, there is also little research regarding how various control types should be executed according to the client knowledge and project requirements volatility. This research theorizes unifying the role of control with client knowledge and requirements volatility. The research results deepen the knowledge on how software outsourcing control efforts should be modified according to each project characteristics such as client knowledge and project requirements volatility. Theoretical and practical implications are discussed.

KEY WORDS

Software, outsourcing, control, requirements volatility.

In the field of software development outsourcing (SDO), control has been recognized as an important means of improving project performance. The term control refers to an outsourcing client's of vendor control activities to ensure that the outsourcing vendor completes the project within the budget and deadlines and assures the quality of the software being developed (Lacity and Willcocks 2017). It is believed that the various forms of formal or informal control undertaken by the client promote the vendor's development efforts to achieve the project objectives and thus the higher the control of the project, the higher the project performance (Choudhury and Sabherwal 2003; Rustagi Gopal and Gosain 2009; Tiwana 2010). In other words, the more the amount of control is applied to the vendor, the better the project performance will be.

However, this perception of the information systems field which had a little chance of being verified cannot be justified. In the real world of SDO, the more outsourcing customers control the vendors, the better the project performance? If we simply think of common sense, there seems to be a little too much to see that increasing the amount of control will improve project performance. For example, is it good to have a lot of control so that customers often have more than enough time to check the vendor's output to improve the project's performance? This study questions the perception of the relationship between control and performance in the SDO. The results of the recent research also show that the combination of types of control may have a negative impact on performance (Lacity and Willcocks 2017; Tiwana 2010) because of the general nature of some types of control (Kudaravalli et al., 2017; Tiwana and Keil 2009-10).

Why is this perception of the relationship between control and performance in the SDO? Much of the research on control in SDOs has applied research results that deal with the control of systems in the information systems sector in practice without much consideration. In a previous study on internal development, control in the development process was found to enhance performance (Henderson and Lee 1992; Kirsch 1996; Kirsch 1997; Kirsch et al. 2002) The more you engage and influence, the more you stimulate the self-control of system

developers through these activities, the higher the project performance (Tiwana and Keil 2009-10).

However, formal control such as output control or behavior control in internal development has been confirmed to be less frequently employed than informal control mechanism, such as self-control. On the other hand, in the outsourcing situation, formal control such as output control or behavior control is more often used than self-control, which is often seen in internal development (Choudhury and Sabherwal 2003; Tiwana and Keil 2009-10). Therefore, the results of the control may also vary significantly, as the content and attributes of the controls exercised in the SDO are different.

Taken together, these findings and limitations of previous research suggest that the implicit belief in the information systems sector that control in the SDO will improve performance needs to be examined a little deeper. The research addresses this gap found in the previous studies. Therefore, in this study, we theorize and investigate the effect of outsourcing customer's control on vendor's performance in SDO. The theoretical foundation is based on the Ouchi(1979)' control theory, and Kirsch(1996, 1997)'s control theory.

The purpose of this study is as follows. First, it is to investigate how the amount of control a client company makes to a vendor affects the SDO project performance. Second, it is to explore the moderating effects of variables such as customer knowledge level (technical knowledge, relationship management knowledge) and requirements volatility between control and SDO project performance.

THEORETICAL FOUNDATION

Different Prior Study Results on Control Effects. Why are there different studies results in this same research topic of control? First, some previous studies (eg Rustagi et al. 2008; Rai et al. 2012) have considered control as a big act without distinguishing between different types of control. However, as revealed in recent research results, control types have a complementary character and have a positive effect on performance, but they have a general nature of each other, so control of such a combination has a negative effect on performance (Kudaravalli et al., 2017; Tiwana 2010). Therefore, if research is conducted without taking into consideration the attributes of such a control type, the influence of control on the performance may be affected not only in the positive but also in the negative or in the negative.

Second, project performance is multidimensional. In other words, it is a concept that includes the efficiency side effects such as the project budget and the deadline compliance as well as the efficiency side effects such as the quality of software developed through SDO (Mitchell 2006). However, the problem is not only that the attributes of project performance are different, but also that the control has a multi-dimensional nature with sub-types with different characteristics. As we have seen in recent studies, some control types, for example, have a positive impact on the quality of software, while output-based output controls have a positive impact on project quality(Lacity and Willcocks 2017; Gopal and Gosain 2009).

Third, it does not take account of the situation variables that can control the impact of the control in the SDO on performance. The impact of control on performance can be influenced by many factors, except for some studies (eg, Gopal and Gosain 2009), where only the relationship between control and performance is assessed without consideration of these situational variables or factors. There are different results among studies. These factors include the factors of the customer mainly exercising control in the SDO, and the factors of the task performed in the SDO. Because the control method and performance to be selected depend on the level of knowledge of the controller, it is possible to consider the technical knowledge of the client and the knowledge of the relationship management in SDO control (Rustagi et al. 2008). And volatility of customer requirements, which is an essential part of the task performed through SDO, will also be an important factor (Maruping 2009).

LITERATURE REVIEW

Research on control in SDOs has been started in earnest since about 2008, and only recently has a related study been published (see Table 1). Previous research has focused on the control of insourcing rather than outsourcing, with the exception of some studies (eg Choudhury and Sabherwal 2003) (Kirsch 1996; Kirsch 1997; Kirsch et al. 2002). Recent research on control in SDOs also assumes or perceives that control improves performance by combining control with in-sourcing (eg Rustagi et al. 2008).

However, the empirical results of the study are different from those of the system development. Some studies did not empirically analyze the effects of control in SDOs on performance at all. Other studies did not aim to investigate the effects of control in SDOs on performance itself, but some of the derived research have found that the effects of control on performance are not only positive but also rather negative and some have found that the impact of control on performance is not significant. Table 1 summarizes the major studies and results of recent control in SDOs.

Table 1 – Prior Study Results on Control in SDO

n/n	Main direction of study result	Previous research	Research findings	Impact of Control on Performance
1	Assuming a positive causal relationship	Rustagi et al. 2008	Identifying factors affecting official control in SDOs	No empirical analysis
		Kudaravalli et al. 2017	Team conflict mediates the relationship between design collaboration centralization and coordination outcomes in SDO.	No empirical analysis
2	Positive and Negative Relationships Mixed	Srivastava and Teo 2012	Identifying the role of outsourcing contracts and control mechanisms in offshore system development	The combination of some control types (mechanical & relational)
		Tiwana 2010	Identifying complementary / alternative roles between formal and informal controls	The combination of informal and consequential control has a negative impact
3	Causality is not found to be significant	Rai et al. 2012	Exploring the interaction effect of relational-contracted governance in BPO	Interaction effect is not significant
		Tiwana and Keil 2009-10	Comparative analysis of control between in-house development and outsourcing development	While internal control has a significant impact on performance, SDO has no significant impact

So, what is the reason why the results of the effects of control in SDOs on performance are presented in three different directions with no coherence? As we have already seen in the background of the study, there are three main reasons for this. First, there are various types of controls that are actually exercised in SDOs, and these types have not only complementary attributes but also alternative attributes (Kudaravalli et al., 2017; Tiwana 2010). However, some studies have considered control as one big act without considering these different types of control, while others have narrowed the control behavior to a more detailed relationship. The researchers have been conflicting with each other.

Second, SDO outcomes not only have multidimensional attributes, but also include effects that offset each other. In other words, SDO is a complex task that must achieve both project efficiency (delivery date and budget) and quality of software produced by the project at the same time. (Wallace et al., 2004). For example, customer-focused outcome control can help improve the quality of the final software, but it can also result in a delay in staffing or delivery (Gopal and Gosain 2009). However, in some previous studies, there is a lack of consistency between previous research results by taking into account only some dimensions without considering the multidimensional nature of the SDO project.

Third, in SDOs, the effects of control on performance are uneven. The reason is that research has been done without consideration of key variables that may affect the

relationship between control and performance. In Gopal and Gosain (2009), there is still a lack of consideration of other variables that control the effect of control on performance, other than the interaction effect between the boundary spanner and control. These variables need to take into account the knowledge attributes of the main control actor (the controller) and the volatility of the customer's requirements on the system to be developed (Rustagi et al. 2008; Maruping 2009).

Therefore, this study focuses on the classification of control types, the distinction between SDO outcomes and the effect of control variables that can affect the relationship between control and performance, which have not been adequately addressed in previous studies. This will contribute to the investigation of concrete measures for improvement of SDO performance, which must clarify causal relationship between control and performance in SDO and achieve various goals. [Table 1] shows the prior study results on control in SDO.

PROPOSITION DEVELOPMENT

The main focus of this study is the following: (1) an empirical study of the effects of control on performance in SDOs; (2) Identify the moderating effects of variables (customer knowledge level, requirement volatility) that could affect the relationship between control and performance.

Influence of Control on SDO Performance. SDO is basically what the outsourcing vendor develops the requirements for the customer's system. According to Transaction Cost Economics (TCE), outsourcing customers and vendors are exposed to opponent's opportunistic behavior because they have different positions and different goals and interests (Williamson 1985). In order to reduce the risk of these opportunistic behaviors and to improve performance, outsourcing customers have various forms of control over the vendors. Unlike in-sourcing development, these controls are dominated by formal controls (outcome control and behavior control), and clan control is an adjunct.

Official control is generally called economic control, and can be a control of the cybernetic point of view to perform instruction, observation, evaluation, feedback and reinforcement of the painter based on rules and standards. Formal control is classified into behavior control and result control again according to the timing of intervention of the controller. Act control affects how the work is performed. (Ouchi 1979). Outcome control, unlike behavioral control, is the assessment of a worker's performance based on defined performance or standards (Jaworski 1988). Unlike official controls, informal controls (clan control and self-control) are based on social strategies that emphasize interpersonal and personal dynamics. Recent research shows that formal control such as behavior control and result control is the main factor in SDO, informal control such as clan control is an auxiliary means, and self control is not exercised by the main control means at the time of internal development have been reported (Tiwana and Keil 2009-10). This study also considers the three types of control except autonomous control according to the recent research results.

Previous research results on system internal development have been reported that control exercised during internal development enhances project performance. These causal relationships are also assumed or perceived as improving control in SDO control studies. In this study, the control exercised in the SDO in concert with the flow of research like this raises the project performance, leading to the following proposition.

Proposition 1. In the SDO, the amount of control the customer makes to the vendor will have a positive impact on project performance.

Moderating Effect of Customer Knowledge and Requirements Volatility on the Relationship between Control and Performance. The level of knowledge that the client has in the SDO can affect not only the choice of control measures but also the performance of the control (Rustagi et al. 2008). For software development through outsourcing, technical knowledge such as understanding the development methodology and development tools used by the vendor is important. In addition to this knowledge, relationship management knowledge, which manages vendors and manages vendor developers working in the development team, is also very important. Depending on this level of technical knowledge

and the level of knowledge of relationship management, the impact of SDO controls on performance will vary. This leads to the following proposition.

Proposition 2. The positive relationship between control and performance in the SDO is controlled by customer knowledge (technical knowledge, relationship management knowledge), and the higher the customer's knowledge level, the stronger the positive relationship between control and performance.

Requirements volatility of SDO clients is an important factor that not only affects project performance, but also influences the choice of control measures and vendor control (Maruping 2009; Tiwana and Keil 2009-10). If the customer's requirements are not clear at the beginning of the SDO project, the outsourcing customer will focus on behavior control or clan control rather than outcome control. It also ultimately affects the performance of SDO projects. Conversely, if the requirements of the SDO project client are clear and the variability and the actual fluctuation are small, this will be the form in which the client will mainly control the result, and the software performance will be improved. This discussion leads to the following Proposition. [Table 2] shows the conceptualization of control types in SDO.

Proposition 3. The positive relationship between control and performance in the SDO is controlled by the volatility of customer requirements, and the higher the variability of customer requirements, the weaker the positive relationship between control and performance.

Table 2 – Conceptualizing Control Types in SDO

Classifications	Constructs	Definitions
Independent variables	Outcome control	The client is required to provide the vendor with the ability to specify, observe, evaluate, feedback, and reward or punish any type of target or standard
	Behavior control	If the customer specifies to the vendor the procedures and methods related to the execution of the project, he / she observes, evaluates, feedbacks.
	Clan control	The client wants the vendor to understand his / her culture and practices, how much he / she understands the vendor and the intangible rewards or penalties
Moderating variables	Customer knowledge	Knowledge of general system development tasks and processes, and understanding of development tasks and processes of the project
	Requirements volatility	User requirements at the beginning of the project are unclear and inaccurate
Dependent variables	Software performance	Technical performance of developed software
	Process performance	The extent to which the development process has been well observed in terms of budget / schedule / goal attainment

DISCUSSION AND CONCLUSION

This study focuses on the fact that previous studies on the control of SDOs resulted in different research approaches and results, and sought to find the root cause of the difference in the relationship between control and performance in the SDO. The results of this study can provide and suggest the following academic implications and practical implications.

The first is to increase the SDO performance rather than the amount of control, rather than the amount of control types that are appropriate for the SDO goal to achieve. To date, control in the SDO field is an important means of improving performance, and it is assumed, or increasing, that SDO performance increases as the amount of control exercised increases. This is basically the result of extending the results of the study on insourcing to the SDO area, which suggests that the control is improved in the internal development of the system, and that the types of control used for internal development and external development are different (Tiwana and Keil 2009-10)

Second, the goals to achieve through SDOs are very diverse and multidimensional,

largely divided into process performance and software performance to be developed. Achieving all of these multidimensional performance goals is unrealistically difficult and, in practice, conflicts and priorities among the different performance goals. In reality, some projects may have software performance developed over SDOs as a more important goal than process performance. In this case, SDO performance can be enhanced if we act more actively in the type of control that can enhance software performance. Thus, this study can provide a direct solution to the problems faced by information system managers in IT outsourcing.

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REFERENCES

1. Choudhury, V., and R. Sabherwal, Portfolios of Control in Outsourced Software Development Projects, *Information Systems Research*, (2003), Vol.14, No.3, pp.291-314.
2. Gefen D., S. Wyss, and Y. Lichtenstein, Business Familiarity as Risk Mitigation in Software Development Outsourcing Contracts, *MIS Quarterly*, (2008), Vol.32, No.3, pp.531-551.
3. Gopal, A. and S. Gosain, The Role of Organizational Controls and Boundary Spanning in Software Development Outsourcing: Implications for Project Performance, *Information Systems Research*, (2009) Vol.20, No.1, pp.1-23.
4. Henderson, J. C., and S. Lee, Managing I/S Design Teams: A Control Theories Perspective, *Management Science*, (1992), Vol.38, No.6, pp.757-777.
5. Jaworski, B. J. Stathakopoulos, V. and Krishnan, S. H. Control Combinations in Marketing: Conceptual Framework and Empirical Evidence, *Journal of Marketing*, (1998), Vol.57, pp.57-69.
6. Kirsch, L. J., Portfolios of Control Modes and IS Project Management, *Information Systems Research*, (1997), Vol.8, No.3, pp.215-239.
7. Kirsch, L. J., V. Sambamurthy, D. Ko, R. L. Purvis. Controlling Information Systems Development Projects: The View from the Client, *Management Science*, (2002), Vol.48. No.4, pp.484-498.
8. Kirsch, L. J., Deploying Common Systems Globally: The Dynamics of Control, *Information Systems Research*, (2004), Vol.15, No.4, pp.374-395.
9. Kudaravalli, S., Faraj, S., & Johnson, S. L., A Configurational Approach to Coordinating Expertise in Software Development Teams, *MIS Quarterly*, (2017), Vol.41, No.1, pp.43-64.
10. Lacity, M., & Willcocks, L., Conflict resolution in business services outsourcing relationships, *Journal of Strategic Information Systems*, (2017), Vol.26, No.2, pp.80-100, <https://doi.org/10.1016/j.jsis.2017.02.003>
11. Maruping, L., V. Venkatesh, and R. Agarwal, A Control Theory Perspective on Agile Methodology Use and Changing User Requirements, *Information Systems Research*, (2009), Vol.20, No.3, pp.377-399.
12. Mitchell, V., Knowledge Integration and Information Technology Project Performance, *MIS Quarterly*, (2006), Vol.30, No.4, pp.919-939.
13. Ouchi, W., A Conceptual Framework for the Design of Organizational Control Mechanisms, *Management Science*, (1979), Vol.25, No.9 pp.833-848.
14. Rai, A., M. Keil, R. Hornyak, And K. Wullenweber, Hybrid Relational-Contractual Governance for Business Process Outsourcing, *Journal of Management Information Systems*, (2012), Vol.29, No.2, pp.213-256.
15. Rustagi, S. King, W. and Kirsch, L., Predictors of Formal Control Usage in IT Outsourcing Partnerships, *Information Systems Research*, (2008), Vol.19, No.2 pp.126-143.
16. Srivastava, S. and T. Teo, Contract Performance in Offshore Systems Development:

- Role of Control Mechanisms, *Journal of Management Information Systems*, (2012), Vol.29, No.1, pp.115-158.
17. Tiwana, A., Systems Development Ambidexterity: Explaining the Complementary and Substitutive Roles of Formal and Informal Controls, *Journal of Management Information Systems*, (2010), Vol.27, No.2, pp.87-126.
 18. Tiwana, A., and M. Keil, Control in Internal and Outsourced Systems Development Projects, *Journal of Management Information Systems*, (2009-10), Vol.26, No.3, pp.9-44.
 19. Wallace L., M. Keil, and A. Rai, How Software Project Risk Affects Project Performance: An Investigation of the Dimensions of Risk and an Exploratory Model, *Decision Sciences*, (2004), Vol.35, No.2, pp.289-321.
 20. Williamson, O. E. *Economic Organization Firms, Markets and Policy Control*, New York University Press, (1985)