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Applying the viable system model in an MCS: Addressing relationships between ERP and budgeting

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ABSTRACT

We apply the viable system model (VSM) in the management control system (MCS) area in order to address the multifarious relationships between enterprise resource planning (ERP) systems and budgeting through the introduction of five research criteria: ERP system, budgeting, informal control, organizational hierarchy and the relationships among them. The research question discussed is: How can we develop an MCS that addresses the relationships among budgeting, ERP systems, informal control and organizational hierarchy? It is found that the VSM application overcomes the limitations in MCS frameworks by addressing the relationships among formal and informal sub-control components across all the organization levels. The main conclusion of the research is that the amended VSM could be used to describe and explain the social aspect between ERP and budgeting in organizations. The unintended use and disconnection of 'ERP as a database' in VSM's system 2 explains why the relationship between 'ERP as a system' and budgeting remains multifarious.

Keywords

The viable system model, Management control systems, Enterprise resource planning systems, Budgeting.

INTRODUCTION

Enterprise resource planning (ERP) systems are one of the most popular IS technologies in today's organizations. ERP vendors typically proclaim the superiority of their systems by claiming that all business functions are available in ERP packages, including a basic management control function like budgeting. At a first glance, it might seem that a relationship between ERP and budgeting is straightforward. This is because it is typically assumed that ERP adopters should have no problem using ERP for budgeting, since it is available in the package. However, research has documented that ERP users do not use the budgeting function available in the ERP system. Instead, users tend to rely on other IS technologies such as Microsoft (MS) Excel and business intelligences (BIs) (e.g. Catt, 2008; Granlund and Malmi, 2002) for budgeting purposes. As a result they conclude that the relationship between ERP and budgeting is *multifarious*.

To study the relationships between ERP and budgeting, we need a framework that allows us to evaluate the relationships systematically. Even though our main purpose is to study the relationship between ERP and budgeting, we argue that it is not sufficient to select or develop a framework that represents only these two components because both budgeting and ERP can be regarded as *social systems*. Budgeting incorporates many social aspects into the process, such as negotiation, participation and gaming between superiors and subordinates (Dunk, 1993). Therefore, it is necessary to incorporate other informal control mechanisms, e.g., norms and cultures, which govern these social aspects of budgeting. An ERP system, on the other hand, is perceived as a social system because even though it is considered to be a mandatory system in that the top management decides to implement the system and mandate the system use, we argue that the *real* decision to use or not to use the system at lower organizational levels is dependent upon *real* system users (DeLone and McLean, 2003). Therefore, the organizational hierarchy is needed in the framework to capture such contradictory ERP use practice at different organizational levels. It is also necessary to address the relationships among informal control and organizational hierarchy as well as ERP and budgeting in order to describe and explain their interactions fully.

Therefore, we propose five criteria required for the framework as follows:

1. An ERP system is a single vendor-based (Light, Holland and Wills, 2001) packaged computer application supposed to support many functions of a company's information needs (Davenport, 2000, p.2), including budgeting functionalities. In addition, we distinguish ERP into two different but related concepts: *ERP as a database* and *ERP as a system* (Dechow and Mouritsen, 2005).
2. Budgeting is an umbrella term in the management accounting and control process, which covers both the set of numbers used for management control purposes and the process of arriving at a budget, thereby including both the term 'budget' and 'budgeting process' (Covaleski, Evans, Luft and Shields, 2006).

3. An informal control mechanism is any activity that organizations undertake to ensure goal compliance beyond accounting-based control mechanisms such as group norms, socialization and culture (Berry, Coad, Harris, Otley and Stringer, 2008; Malmi and Brown, 2008).
4. An organizational hierarchy is an organizational arrangement in which leaders direct subordinates. We adopt Anthony's management control theory (1965), which depicts the organizational structure through the identification of three main functions – operational control (operational management), management control (middle management) and strategic planning (top management) – as the basis for defining the organizational hierarchy.
5. Relationships are “the way in which two or more [...] groups regard and behave towards each other” (Oxford Dictionaries, 2011). We postulate that two-way communication channels between components are needed to allow related components to behave towards one another.

To meet these five criteria, we focus on management control systems (MCSs) research because it represents frameworks that bring together scattered knowledge on sub-organizational control mechanisms, both formal accounting controls and informal controls, to examine the interdependencies and relationships among them (Ferreira and Otley, 2009). We claim that an MCS framework could be of assistance when studying the *multifarious* relationship between budgeting and information system (IS) technologies like ERP systems.

Following the aforementioned arguments, we propose the research question: How can we develop an MCS that addresses the relationships among budgeting, ERP systems, informal control and organizational hierarchy?

This paper proceeds as follows. The next section reviews the MCS frameworks currently available in the accounting literature in an attempt to select an available MCS framework that can be applied to our research criteria. We analyze two MCS frameworks, levers of control and performance management systems, in light of the proposed criteria. We conclude that these are not good enough. Left with the choice of developing our own MCS, section 3 introduces a non-MCS framework – the viable system model (VSM) – and discusses why the VSM meets our research criteria. Section 4 applies the VSM as an MCS framework in order to incorporate the interconnections among budgeting, ERP systems, informal control and organizational hierarchy. Section 5 provides some conclusions and contributions and suggests some future research.

MANAGEMENT CONTROL SYSTEM FRAMEWORKS IN THE ACCOUNTING LITERATURE

In this section, two popular accounting-based MCSs, Simons's levers of control and Ferreira and Otley's performance management systems, are reviewed and discussed. These frameworks are selected over the other available MCS frameworks because they represent an influential force over a current MCS field, are widely cited (Berry et al., 2008) and incorporate the organizational context into the frameworks. The aim of this section is to build up an argumentation that describes why these frameworks could be seen as insufficient when exploring the relationships between ERP and budgeting.

Simons's Levers of Control Framework

Simons's levers of control (1994, 1995) (LOC) is an MCS framework that aims at implementing and controlling business strategy. The framework centers on balancing four key control mechanisms – belief, boundary, diagnostic control and interactive control systems – in order to manage behavior, which results in successful strategic change. Each key control is influenced by its own key component, which defines how each control strategy plays out in practice. The concepts and related components are described as follows:

- Belief systems define the common basic values, purpose and direction for organizations. *Core values* reflected in formal documents, e.g., mission statements, define organizations' belief systems.
- Boundary systems establish the concrete limits, rules and minimum requirements that need to be respected by the organizational members. *Business risk* analysis influences the design and intensity of boundary systems, for example codes of business conducts and strategic planning systems.
- Diagnostic control systems constitute formal feedback systems employed for monitoring outcome and correction purposes in order to support the current strategic plan. *Critical performance variables* direct diagnostic system designs, e.g., budgets and business plans.
- Interactive control systems depict top management's personal participation in subordinates' decision making to enforce consistent discussions and learning throughout organizations. *Strategic uncertainties* signify the importance of and emphasis on diagnostic control systems.

Recent research (Tuomela, 2005; Weidener, 2007) reports evidence confirming Simons's argument (1995) that all four LOC key control mechanisms are interdependent and complementary when used both diagnostically and interactively (Tuomela, 2005).

Like any other framework, LOC has both strengths and weaknesses. LOC demonstrates significant strengths over other MCS frameworks by offering a broad control perspective (Ferreira and Otley, 2009) and specifically addressing *how* managers can purposefully employ different control mechanisms to achieve strategic goals. Despite its strengths, LOC entails some critical weaknesses. First, LOC application centers on top-level management, therefore it is ill-applicable in other organizational levels. In addition, it does not cope well with the ranges of informal controls that usually exist in smaller organizations (Ferreira and Otley, 2009). As a result, LOC is unlikely to constitute a universal control framework. Second, though Simons attempts to include some informal controls in the framework (Berry et al., 2008), the LOC belief systems do not include other significant informal control mechanisms such as group norms, socialization and culture (Collier, 2005). Third, neither IS technologies nor communication channels, which represent how sub-controls communicate or align together, are presented in the framework. The next section introduces Ferreira and Otley's performance management systems.

Ferreira and Otley's Performance Management Systems

Based on the work of Otley (1999) and LOC, Ferreira and Otley (2005, 2009) developed a new framework called performance management systems (PMSs), which include both the formal and the informal control mechanisms used in organizations. PMSs consist of twelve components. Eight of them are connected in a one-way top-down fashion in the PMS inner ring (Figure 1) – vision and mission, key success factors, organization structure, strategies and plans, key performance measures, targeting setting, performance evaluation and reward system. The remaining four components – PMSs change, PMSs use, strength and coherence, information flows, systems and networks – are presented in the outer PMS ring, signifying their contextual settings, but not relationships, to the inner rings. In contrast to LOC, PMSs do not address *how* they can be used for organizational control; PMSs address *what* factors are to be considered in organizational control.

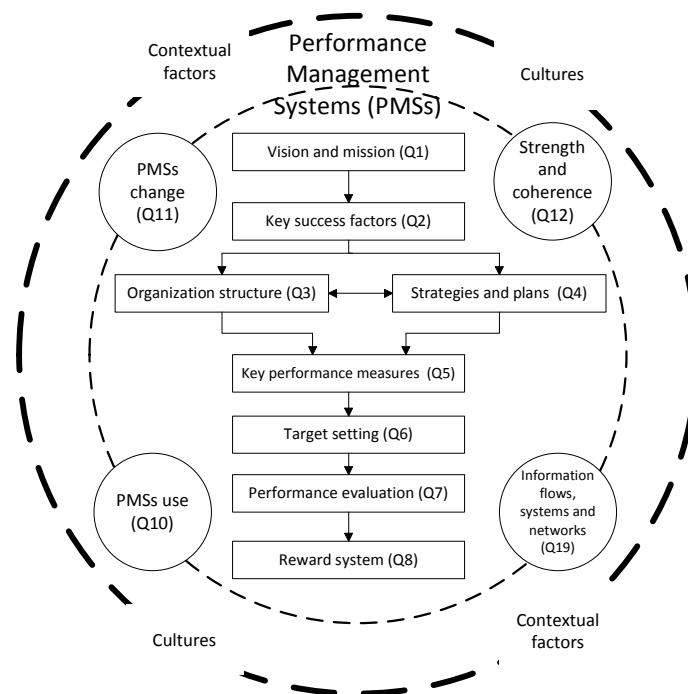


Figure 1. Performance management systems (Ferreira and Otley, 2009)

The strengths of PMSs lie in their recognition of both formal and informal control mechanisms. These are absent from the LOC framework. Moreover, PMSs were constructed from longitudinal studies (e.g. Ferreira and Otley, 2005) and were empirically tested (e.g. Tuomela, 2005). In terms of weaknesses, PMSs are, first, criticized for limited model applicability at the top-management level (Stringer, 2007). Second, the relationships among the PMS components are not well defined (Berry et al., 2008). PMSs neither explain why the components in the inner ring are connected in a one-way top-down approach nor explain the relationships between the inner ring and the outer ring. Third, though IS technologies, especially ERP systems, are mentioned in the framework (under the *information flows, systems and networks* grouping), their relationship to and implication for the rest of the model are unclear (e.g., how we can link IS technologies with strategies and plans). The next section compares both LOC and PMSs against our five criteria presented in the introduction section.

Comparison between LOC and PMS and Five Research Criteria

Both LOC and PMS are widely accepted MCS frameworks; from our analysis we present a comparison of LOC and PMS against our five search criteria in Table 1.

Research criteria	LOC	PMSs
1. ERP system	No – Simons does not make it explicit in the framework.	Yes – in information flows, systems and networks.
2. Budgeting	Yes – implicit in diagnostic control.	Yes – implicit in key performance measures, targeting setting and performance evaluation.
3. Informal control mechanism	No – LOC emphasizes mainly a formal control mechanism.	Yes – in performance evaluation.
4. Organizational hierarchy	Yes – implicit in the interactive control system.	Yes – in the organizational structure.
5. Relationships	No – LOC only depicts that management must balance the four key controls.	No – only partial one-way relationships are presented in the PMS inner ring.

Table 1. Comparison of LOC and PMSs with the research criteria

Our analysis has shown that PMSs seem to be a better candidate than LOC according to our criteria. However, we decide that both frameworks are still inappropriate for our research purpose. PMSs' absence of two-way relationships makes them insufficient to achieve our primary research aim, which is to address the two-way relationship between ERP and budgeting.

For these reasons, we decide that PMSs and LOC cannot be selected as our research framework. We therefore decide to develop our own MCS. We look outside the accounting literature in order to consider whether other areas offer any other control frameworks that can be applied to our criteria. We come across Stafford Beer's viable system model from the operational control literature, which we find useful. The model will be presented next.

THE VIABLE SYSTEM MODEL

This section begins with a basic introduction to the viable system model (VSM), which is the famous work of Stafford Beer, the founding father of cybernetics. The VSM is structured according to the basic assumption that all organisms or organizations share one ultimate purpose, which is to *survive*. Therefore, the VSM specifies the necessary and sufficient conditions for any systems to be viable or "capable of independent existence" (Beer, 1984). The model is applicable to every system at all levels. After the introduction, we explain how the VSM responds to our research criteria. We postulate that the VSM meets all of our criteria; however, we claim that the organizational hierarchy criterion of the VSM is not clear in the existing VSM research. Therefore, we compare the VSM with the management control theory, LOC and PMS frameworks in order to demonstrate that (1) the VSM spans throughout organizational levels and (2) the VSM is comparable with LOC and PMSs.

The Basics of the Viable System Model

The VSM provides a detailed view of *what* management structure should be there and *how* organizational control should be formed (Leonard, 2009) in order to ensure its survival. The VSM operates on three principles: the principles of viability, recursion and autonomy (Schwaninger, 2006).

The first principle of viability defines five functions that a system must achieve and specifies the communication pattern (feedback and feed-forward) that governs the system and its interaction with environments. These five subsystems in the VSM (Figure 2) are:

- System 1 (A–D) and its environment: indicate basic independent *operational units* that adapt to the immediate environment, i.e., its own market segment, in order to ensure its independence and survival.
- System 2: represents coordination activities among operational units (system 1) that ensure consistency, efficiency and smoothness of the entire system since it is always possible that operational units do not synchronize with one

another. Communication technologies and corporate accounting services are examples of coordination activities in this category (Leonard, 2009).

- System 3: establishes the overall optimum among the operational units. The VSM, which operates for the best interests of the entire system rather than its parts, may lead to conflicts of interests and competitions for resources among the operational units. Management accounting techniques such as budgeting are employed to establish a resource-allocation basis (Leonard, 2009). System 3 is connected with the rest of the system.
- System 3*: denotes investigation and validation of information flows in systems 1, 2 and 3 through auditing or monitoring activities.
- System 4: indicates an organizational attempt to anticipate future environments to evaluate strategic moves in respond to changing business conditions. System 4 operates in congruence with system 3 to introduce changes successfully.
- System 5: ascertains organization identity such as boundaries, cultures, norms, values and rules so as to ensure that individuals are doing the right things rather doing thing rights (Schwaninger, 2000). System 5 often operates in synchronization with systems 4 and 3.

The systems are each connected with one another and the environments through two-way communication channels (as represented by two-way arrows in Figure 2) or relationships. This signifies that what happens in one system will have an impact on the other systems.

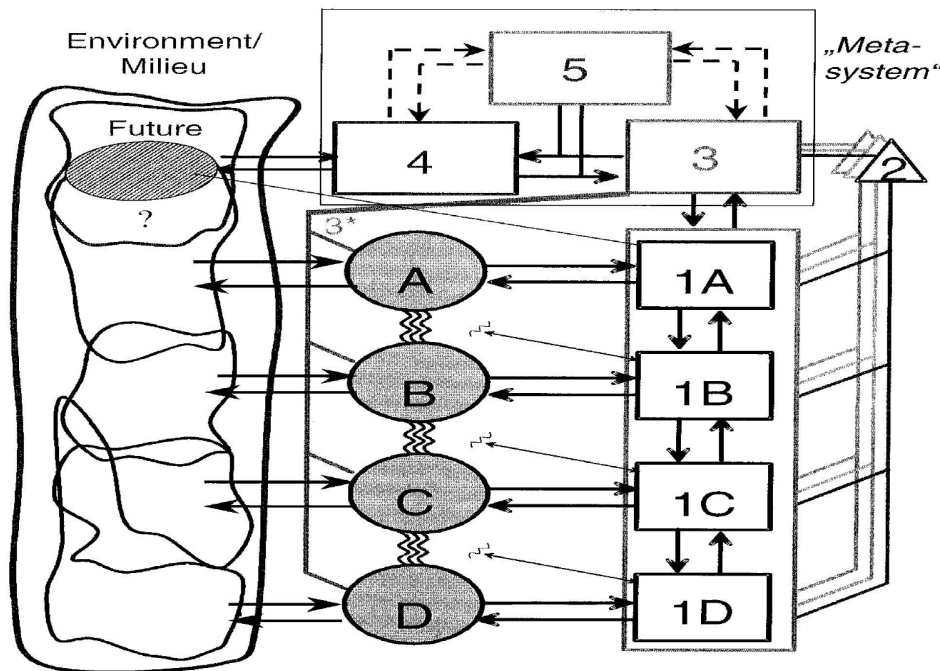


Figure 2. The viable system model (Beer, 1985)

The second principle of recursion regulates that for any system to be viable, all the functions in the principle of viability must be recursively presented at all levels of the organization. A viable organization is made up of many viable units and is in itself embedded in a more comprehensive viable unit (Schwaninger, 2006). This principle magnifies itself to constitute that taken together, systems 5, 4 and 3 compose the meta system (i.e., middle-top-level management) for a given level of incursion while systems 3, 2 and 1 represent the operational system (i.e., middle-operational-level management) at the same level of incursion (Bititci, Carrie and McDevitt, 1997). The inclusion of system 3 (i.e., middle-level management) as part of both meta and operational systems signifies its key role as the hinge between current operations and future planning and strategic changes. Lastly, the third principle of autonomy establishes that any viable system has both freedom and responsibility to regulate itself. Such autonomy is not complete, but is regulated by internal checks and balance among sub-systems as implicated in system 3*.

The VSM's advantages lie in its clear and mandatory relationships with other sub-subsystems. This improves the VSM's strengths in terms of the theoretical claims and the diagnostic potency (Schwaninger, 2006). Some criticisms of the VSM maintain that the VSM is hostile to human freedom and democracy because control is contradictory to liberty (Thomas, 2006); we disagree with this point because it contradicts the principle of autonomy discussed previously.

We choose to apply the VSM as the MCS literature because it satisfies our five criteria. The ERP systems and budgeting criteria are satisfied in systems 2 and 3, respectively (Leonard, 2009). Informal control is included in system 5 (Schwaninger, 2000). The relationships among components, as indicated by two-way arrows among components, are explicit in the original VSM. The only factor that we are convinced the VSM contains, but is not explicit in other research, is organizational hierarchy. Therefore, we will analyze the VSM with the traditional organizational structure as well as comparing the VSM with LOC and PMSs in the next section to demonstrate that (1) the VSM spans throughout the organizational levels and (2) the VSM is comparable with the LOC and PMSs.

Clarifying the Organizational Hierarchy in the VSM and Comparing the VSM with LOC and PMSs

To achieve the first objective, which is to demonstrate that the VSM spans throughout the organizational hierarchy, we compare the VSM with the management control theory by Anthony (1965), which depicts the organization structure. For the second objective, we compare the VSM with the LOC and PMS frameworks. The original VSM, LOC and PMS components and their descriptions are used to compare them against the management control theory. The result is demonstrated in Table 2.

Management control	VSM	LOC	PMS
Operational control – Operational management	System 1	Not explicit	Not explicit
	System 2	Not explicit	Not explicit
Management control – Middle management	System 3	Diagnostic control systems	Target setting Performance evaluation
Strategic planning – Top management	System 4	Interactive control systems	Organization structure Strategies and plans Key performance measurement PMSs change PMSs use Reward systems
	System 5	Belief systems Boundary systems	Visions and missions Key success factor
Others	Two-way communication channels Interaction with environments	Not explicit	Information flows, systems and networks Strength and coherences

Table 2. Comparison of the VSM, LOC and PMS frameworks with the organizational structure

The analysis results show that the VSM in comparison with the management control theory is applicable to all organizational levels. The model focuses on the top, middle and operational management levels. The inclusion of system 3 in both meta and operative systems emphasizes the relationship between operational management and top-level management through interaction at the middle management level. This is an advantage over both LOC and PMSs, which focus only on the top to middle management levels. In addition, the VSM is comparable with LOC and PMSs in many respects; the core concepts of these three frameworks are similar and complementary as we have shown that we can match most LOC and PMS components with the VSM. However, we hold that the VSM is superior due to its precise indication of relationships among systems.

As we have shown that the VSM meets all our research criteria, we decide to amend the VSM in the MCS literature in order to address the relationships between ERP and budgeting in the following section.

APPLYING THE VIABLE SYSTEM MODEL IN AN MCS

This section presents our attempt to apply the existing VSM to address an MCS framework that incorporates our five research criteria. We begin discussing the concepts presented in the existing ERP and VSM literatures at each individual system level, and then discuss the aggregated model on the interconnection among systems. Finally, we propose the amended VSM model.

At an individual system level, the literature addresses how the VSM can be used in complex organization contexts. Schwaninger (2000) proposes that systems 5 and 4 in the original VSM can be termed *normative* and *strategic* management, respectively. He argues that the main function of system 5 or *normative management* is to promote the organizational identity through the management of norms, values and rules, and the key function of system 4 or *strategic management* is to sculpt the future organization according to its environments. Leonard (2009) complements Schwaninger by vividly demonstrating how the VSM can be used in complex organizations for management purposes. She shows that system 3 is where executive functions take place and important resource-allocation decisions are made. Budgeting is often the mechanism introduced in this system to assist the resource-allocation processes. She further argues that system 2 is any coordination activities performed in organizations and specifically argues for the applicability of IS technologies in system 2. In order to introduce ERP into system 2, we adopt Dechow and Mouritsen's (2005) distinction between (1) 'ERP as a database' technology, which argues that an ERP system acts principally as a database and nothing else, and (2) 'ERP as a system,' which argues that ERP only becomes a completed system through design and use. Here, in system 2, we employ the limited interpretation of 'ERP as a database' since its main job function is to work as a big coordinating calculation machine (Cooper and Kaplan, 1998) according to Leonard's interpretation. System 1's implication for organizations remains true to the original interpretation from Beer, which is the basic operational units, e.g., the production of products and services.

At an aggregated level, the concept of 'ERP as a system' (Dechow and Mouritsen, 2005; Orlikowski, 1992), which emerges through ERP design and use, is employed to represent the relationships among all five systems. This concept of ERP as a system is important in addressing the social aspect of both budgeting and ERP systems. ERP systems (system 2) can be seen as a rationalization tool in a budgeting game in order to justify the budgeting decisions that have already been made (Earl and Hopwood, 1980) since the game takes place between operational (system 1) and top (systems 4–5) managers through middle managers (system 3). At the same time, although it might seem that a decision to use ERP is mandatory from the top management level (system 4) once the system, i.e., ERP as a database, is implemented, the *real* decisions to use or not to use it at lower organizational levels, i.e., systems 1, 2 and 3, affect how ERP relates to other sub-systems (DeLone and McLean, 2003) and how ERP plays out as a *social* system. Therefore, the concept of ERP as a system magnifies itself to show a system use contradiction among different organizational levels. For example, if ERP as a database is bypassed in system 2 for budgeting purposes, users often come up with their own way of working around the system through MS Excel spreadsheets or BIs in an attempt to remain connected to the rest of the system. The unintended use and disconnection of system 2, or *ERP as a database*, explains why the relationship between ERP at the aggregated level, or *ERP as a system*, and budgeting remains *multifarious*. Figure 3 depicts the newly adapted VSM.

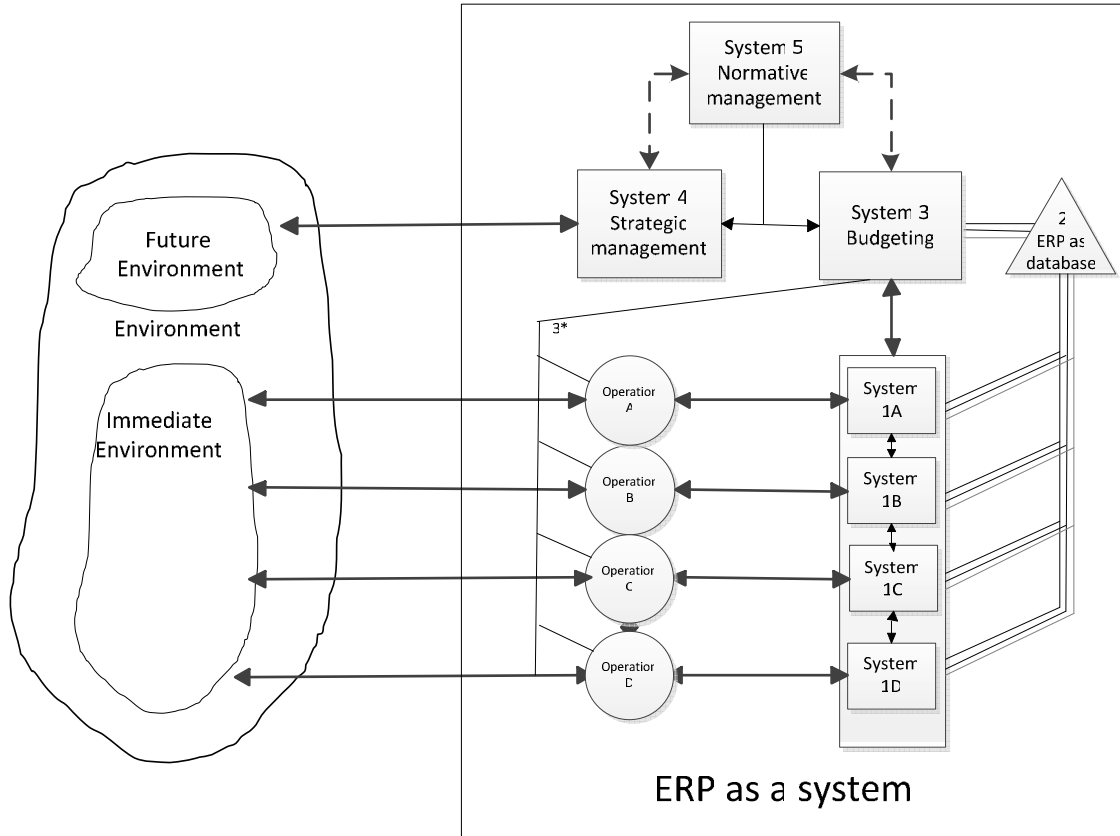


Figure 3. The amended VSM for budgeting and ERP

CONCLUSION

In this paper we present an application of the viable system model (VSM) in management control system (MCS) research to discuss the research question: How can we develop an MCS that addresses the relationships among budgeting, ERP systems, informal control and organizational hierarchy? The VSM is chosen over other MCS frameworks, i.e., levers of control (LOC) and performance management systems (PMS), because our analysis has shown that the VSM is not only complementary to LOC and PMSs but also superior because of its abilities to focus on the interrelationships between formal and informal control mechanisms at all organizational levels. The main conclusion of the research so far is that the amended VSM could be used to describe and explain the relationships between ERP and budgeting as well as their social aspects in organizations. The unintended use and disconnection of ‘ERP as a database’ in the VSM’s system 2 explain why the relationship between ‘ERP as a system’ and budgeting remains multifarious.

This paper contributes especially to the MCS literature by extending the VSM and thereby overcoming the current significant criticisms in the MCS literature by (1) addressing the relationship among the sub-control components across all organizational levels and (2) stating the IS technologies’ relationship to organizational control by showing that IS technologies can be regarded as both a tool (‘ERP as a database’) and a social system (‘ERP as a system’). At the same time, the VSM’s application in organizations can be of interest to practitioners who are interested in *what* and *how* to manage organizations. The framework shows components to be considered in a budget control environment and how practitioners can manage the relationships. Users’ choice to work around ‘ERP as a database’ with MS Excel or BIs interrupts the entire system flow and disconnects top management insights from operational and management controls. It can be claimed that future research using the amended VSM as a framework to clarify relationships would be beneficial for both organizations that have implemented ERPs and ERP vendors in the future development of ERPs.

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