INSTITUTIONAL LOGICS AND LOOSELY COUPLED PRACTICES: THE CASE OF NASA’S ENTERPRISE INFORMATION SYSTEM IMPLEMENTATION

by

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Institutional Logics and Loosely Coupled Practices: The case of NASA’s Enterprise Information System Implementation

Abstract

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This dissertation reports on an exploration of the interaction of standardized, linear, mechanistic enterprise information systems with the often pluralistic, nonlinear, organic contexts into which they are introduced. This exploration involves three independent studies: (1) a qualitative meta-analysis of published, interpretive case studies on the adoption of enterprise systems; (2) a study of conflicting institutional logics and loose coupling in the wake of NASA’s ERP implementation; and (3) a study of the dynamics of this loose coupling and related effects across the four years post implementation.

The goal of the research is to theorize about the causes and effects of loose coupling between local practices and an enterprise system. Findings indicate that in situations where the institutional logics associated with incumbent practices conflict with the institutional logics of the enterprise system, the result will likely involve some form of loose coupling between those practices and the system. Local responses to the system are not uniform within organizations nor within communities of practice, but instead appear to align with society’s broader institutions that guide micro-level behavior. Thus, the
theoretical device of an institutional logic is put forth to aid researchers in explaining regularities in adaptive behavior associated with enterprise systems within institutionally pluralistic organizations.

This research also finds that incidents of loose coupling early in the implementation tend stabilize over time into states of loosely coupled equilibrium rather than into the tight alignment that is often assumed to be necessary for system success. Thus, “stability” is found to be a key objective relating to enterprise system implementation in addition to the presumptive goals of integration and control. The relationships between loosely coupled stability, integration, and control are multifaceted across three levels of analysis: (1) activities within processes; (2) overall processes; and (3) the organizational level. Loose coupling that undermines integration and control associated with activities in an organizational process can be vital to establishing the enterprise system stability. This stability, in turn, may enable certain forms of integration and control at an overall process level of analysis. Further, due in part to the legitimizing influence that a stable enterprise system affords, the tightly coupled enterprise system can counter-intuitively be viewed as an enabler of NASA’s loosely coupled organizational structures.
Institutional Logics and Loosely Coupled Practices: The case of NASA’s Enterprise Information System Implementation

Chapter 1   Introduction

Organizations spend billions of dollars annually on enterprise information systems such as enterprise resource planning (ERP). These systems are intended to enable the widespread integration and control of processes across and between organizations, largely through the application of linear and mechanistic assumptions about relevant organizational activities (Davenport 1998; Ciborra 2000). Organization theory cautions us, however, that certain forms of organizations and certain domains within organizations are not entirely consistent with process-oriented, rationalized, mechanistic principles (Scott 1987). As the reach of enterprise systems continues to stretch to different forms of organizations and across ever-more diverse practices, it is imperative that researchers and practitioners understand more about the interaction of these enterprise systems with the often pluralistic, nonlinear, organic contexts into which they are introduced.

If one were to view organizations as mechanistic, tightly integrated, and purely bureaucratic forms, then perhaps a standardized, highly integrated system could well address the information and coordination needs of the organization. However,
since organizations are subject to change and uncertainty on many different fronts, organizational theory has long understood the need to loosely couple different portions of the organization (Thompson 1967; Lawrence & Lorsch 1967; Galbraith 1977) to enable flexibility, adaptability, and innovation. Therefore, the dream of an enterprise information system tightly integrating and controlling all of the processes within an organization will forever remain an impossible dream. Naïve assertions (that can still be found in certain domains) of enterprise systems one day enabling the perfect integration and control of all processes within an organization simply do not appreciate the complexity, nonlinearity, diversity, uncertainty, and change involved in the ongoing daily practices of individuals within organizations.

More reasonable arguments for the promise of enterprise information systems, however, assert that while a single system cannot do everything, there are certain domains, or business processes, where tight integration and control make sense. Across such domains, enterprise information systems offer firms generic templates for realizing organizational “best practices” (Wagner et al 2006) in guiding those activities that can, and (implicitly) should, be rationalized and streamlined. These domains are often financially focused and have well-known designations such as “order-to-cash” and “procurement.” Even with this unassuming view of enterprise system control and integration, organizations respond to enterprise systems with a wide variety of local misalignments and idiosyncratic appropriations at the local level (Sia & Soh 2007; Bourdieu & Robey 2005). These misalignments are becoming increasingly important, as enterprise systems continue to expand within organizations over time (Markus & Tanis 2000), the boundaries of organizational
processes tend to expand and sweep in broader and more diverse contexts within and across organizations.

Researchers are continually challenged with making sense of the local appropriation of enterprise systems. While some researchers make a case that enterprise systems represent fairly deterministic pressures on organizations (Gosain 2005; Kallinikos 2004), others address the limitations of this determinism and focus on the situated reactions (Ciborra 2000; Boudreau & Robey 2005; Elmes et al 2005). In such cases the materiality of the enterprise system cannot be ignored (Volkoff et al 2007), but can be appropriated idiosyncratically.

In virtually all of the treatments of enterprise systems in organizations, there is a pervading presumption that in order to be a successful, the enterprise system must, to some extent, align with the relevant organizational practices (Davenport 1998). This means that the system structures portions of the relevant practice, and is appropriated by individuals in some way to perform that practice. In situations where there are a deep misalignments relating to conflicting institutional structures, eventual alignment can conceivably never be reached and the implementation will fail (Sia & Soh 2007). This assumption of the relationship between alignment and success seems to run contrary to cases in which enterprise systems seem to exist quite satisfactorily over time where practices minimally appropriate the enterprise system, and are, in turn, minimally structured by the enterprise system (e.g., Wagner & Newell 2006; Pollock & Cornford 2004; Ciborra & Faillia 2000). However, there is little explicit attention to the possibility of a successful enterprise system
implementation without complete alignment. In this research I explore this possibility, and do so based on two observations from the literature on enterprise systems: (1) that certain contexts may have deep, structural misalignments with an enterprise system; and (2) that aspects of the relevant process that involve the enterprise system functionality and process objectives may be loosely coupled from the local, situated practices that comprise that process.

Given these two observations, I draw upon institutional theory and the metaphor of “loose coupling” to theorize about the possibility of incomplete alignment in an enterprise system implementation, as well as its causes and effects. Next I will briefly attend to key concepts of institutional theory and loose coupling, and then introduce my research.

1.1 Institutions and Information Systems

Deterministic arguments about the impacts of information technology, such as those posed by Leavitt & Whistler (1958), are virtually extinct. Instead, there is a widespread appreciation of the idiosyncratic, unanticipated ways in which information technologies are appropriated in locally situated contexts (Barley 1986; Orlikowski 1992). However, even as the importance of ‘situatedness’ is now widely acknowledged, Scott (1990) cautions researchers to be careful not to abandon the pursuit of consistencies or regularities that can be identified in relation to technology appropriation. Institutional theory is concerned specifically with regularities across social contexts. In doing so it offers a potentially fruitful lens for studying the appropriation of new information technology (Orlikowski & Barley
2001). The institutional perspective can inform systemic and structural understandings that take into account not only techno-rational explanations, but also social, normative, and political considerations beyond the immediate context of the system and its use (Orlikowski & Barley 2001).

Institutions are predefined patterns of conduct that individuals draw upon to guide their everyday practices. As such, they are social constructions that exist outside of any particular individual, yet are perceived as “objective” reality by individuals (Berger & Luckman 1967). Institutions are necessarily historical in character, and they continually reproduce and persist over time – they are “the enduring features of social life” (Giddens 1984, p.24). Thus, institutional theory offers a lens for analyzing goals, values, and prescriptions that underlie and legitimate behaviors of groups and individuals (Powell & DiMaggio 1991).

Friedland and Alford (1991) argue that institutions can be studied on three levels – individuals, organizations, and society – and they introduce the theoretical device of an “institutional logic” as a mediating concept between these levels of analysis (Friedland & Alford 1991, p.242). Institutional logics are the symbolically-grounded organizing principles that underpin individual practices – both the means and the ends of those actions - in a manner consistent with a given institution (Friedland & Alford 1991). Society is comprised of a variety of often-contradictory institutions (Friedland & Alford 1991), and these conflicting institutions necessarily remain more or less decoupled from each other (Meyer & Rowan 1977).
As “carriers” of institutional structure (Scott 2008), information technologies can be said to embody specific institutional logics (Gosain 2004). Since organizations are increasingly thought to be influenced by a variety of often conflicting institutions – a concept known as “institutional pluralism” (Kraatz & Block 2008) - the logic associated with a newly-introduced enterprise information system can either be congruent or in conflict with the incumbent logics of the organizational practice. Assuming the continued use of the system, it is my argument that in situations where the logic of the system is in conflict with the logic that guides incumbent practices, the result will be the loose coupling of the practice from the system. It will not result in tight coupling (which is typically the intention of the implementers of the enterprise system) without fundamentally changing the practice. Similarly, the system cannot be entirely decoupled from practice and still be “used.”

In accordance with this insight, I propose to leverage the notion of “institutional logics” (Friedland & Alford 1991) to bridge the local practices related to information systems in diverse contexts with the institutional order in which these practices are embedded. In using this institutional lens, I argue that specific regularities can indeed be identified. In particular, I suggest that practices which are guided by institutional logics that are in conflict with the prescriptions of a newly introduced enterprise system will tend to loosely couple with that system.

1.2 Loose Coupling
Loose coupling refers to patterns of action that are distinct, or separate from each other, yet are still responsive to each other in some fashion (Orton & Weick 1990).
Loose coupling is a dialectic concept intended to offer an alternative to both tightly coupled and decoupled system concepts. Tightly coupled systems are highly integrated and responsive to each other, while non-coupled systems are completely separate and unresponsive (Orton & Weick 1990). Loose coupling indicates the presence of both decoupling and tight coupling.

Loose coupling is adaptable to multiple levels of analysis (technical, conceptual, social, organizational, supra-organizational, etc.) and can be used as a construct in support of multi-level theorizing, and as both a dependent and independent variable (Orton & Weick 1990). The idea of loose coupling is evident in a wide variety of studies across disciplines and theoretical positions. While the idea of loose coupling is implied in much of the classic organizational literature (e.g., Gouldner 1956; Blau & Scott 1962; Thompson 1967; Lawrence & Lorsch 1967), the term itself was popularized by Weick (1976), and was then adopted by a variety of management researchers (e.g., Meyer & Rowan 1977; Hannan & Freeman 1977; Pfeffer & Salancik 1978; Mintzberg 1979; Perrow 1984). Thus it is quite consistent with classic management theory to view organizations as comprised of subsystems which vary in their degree of loose and tight coupling with each other (Scott 1987; Weick 1979).

Although loose coupling is evident in some qualitative descriptions of information system implementations (e.g., Pollock & Cornford 2004; Wagner & Newell 2004), the concept has not been addressed at length in information systems literature. Instead, the literature typically recognizes two broad responses to new information systems - adoption (Davis 1989; Venkatesh et al 2003) or resistance (Hirschheim &
Newmann 1988; LaPointe & Rivard 2005). Even in treatments where misalignments between the system and its context abound (Leonard-Barton 1988; Orlikowski 1996; Majchrzak et al 2000; Soh & Sia 2004; Boudreau & Robey 2005), the literature emphasizes a process of mutual adaptation toward some form of eventual alignment. In the rare cases where the literature does allow for the possibility of simultaneous acceptance and resistance (e.g., Marakas & Hornik 1996), the explanation does not involve distinctive, identifiable patterns of activity that exist across time and across contexts. In this research I combine an institutional view of organizations with the notion of loose coupling to engage in three independent, yet related (i.e., loosely coupled) research studies about alignment and enterprise information systems.

1.3 Research Summary

To explore the loose coupling of a new information system with incumbent practice, this study focuses of enterprise information systems such as enterprise resource planning (ERP). These systems grew out of the accounting and manufacturing functions, and have been said to embody, or be inscribed with, a specific, consistent, institutional logic that can be identified as managerial rationalism (Gosain 2004). Organizations, on the other hand, are comprised of a variety of nested institutions, some of which are compatible, while others conflict (Kraatz & Block 2008). Conflicting institutions coexist within the same organization by virtue of their loose coupling with one another (Meyer & Rowan 1977). Since organizational practices necessarily draw upon specific institutional logics to guide everyday action (Powell & DiMaggio 1991; Bourdieu 1977), some of these practices will be congruent with
the processes inscribed into the enterprise system, and others will conflict. It is a fundamental assertion of this thesis that organizational practices that are congruent with the institutional logics embodied by the enterprise system may realistically be tightly coupled with that system, while practices that are incongruent will necessarily remain loosely coupled from the system, or fundamentally change and become different practices altogether.

Enterprise systems are particularly well-suited to institutional analysis (Gosain 2004; Soh & Sia 2004; Sia & Soh 2007) because they are large-scale systems intended to integrate processes across an entire enterprise. As organizations typically lie at a locus of multiple, often inconsistent institutions, institutional analyses of enterprise system implementations can prove particularly fertile for assessing a variety of outcomes within a given organization or across organizations. In this institutional research, I explored the loose coupling between incongruent institutional logics associated with an enterprise system implementation in three distinct studies. Next I will briefly introduce each study and highlight key findings.

The first study (Appendix A) involves an innovative research technique that can be described as “qualitative meta analysis.” This methodology is based on Noblit & Hare’s (1988) concept of a meta-ethnography, and only recently does it appear to be gaining in popularity in domains such as healthcare and education, particularly in the United Kingdom (Jones 2004). Qualitative meta analysis involves treating descriptive data that is evident in published articles as primary data, which is then reinterpreted within the frameworks and for the purposes of new research.
Through a qualitative meta analysis of eighteen published case studies, I find support for a theoretical framework concerning the relationship between congruence of institutional logics, forces through which enterprise systems are introduced, and outcomes of the implementation that include faithful appropriation, loose coupling, resistance, and manipulation of the implementation. In particular, this analysis highlighted the ubiquity of loosely coupled activity across implementations, and at the same time the dearth of any systematic theorizing about loose coupling, its dynamics over time, the mechanisms that enable loose coupling, forms of loose coupling, and effects of loose coupling. The following two studies begin remedying this situation through an analysis of NASA’s ERP implementation.

The second study (Appendix B) involved a grounded analysis (Strauss & Corbin 1998) of the nine months following NASA’s ERP “go live.” NASA was a particularly appropriate environment for the study of loose coupling and institutional logics, because the agency is awash with a variety of conflicting institutions, and has many loosely coupled structures (Vaughan 1996). Further, its experiences resonate with a wide variety of organizations (Farjoun & Starbuck 2007). NASA, as a highly-politicized government agency dealing with some of the most radical innovations and acute reliability concerns is an extreme case (Yin 2003) on many fronts, and therefore particularly well-suited for the generation of theoretical insight. The research primarily focused on understanding four situations that involved the loose coupling of NASA’s practices with the enterprise system, through the analysis of 68 interview transcripts and assorted other documentation. Our findings confirmed
that responses to enterprise systems appeared to align with our institutional framework, and that the loose coupling that was evident took broadly different forms (i.e., temporal, structural, material, & interpretive), and was enabled by a number of different mechanisms. Perhaps most importantly, however, we found that this loose coupling was not evident according to traditional boundaries of communities of practice or functional groups. Rather, the evidence suggested that stratification of organizational actors according to espoused institutional logics appear to better explain appropriation behaviors. While these first two studies focused primarily on understanding the causes and enablers of loose coupling in enterprise system contexts, the third study focused on effects and dynamics of loose coupling over time.

The third study presents an in-depth two-step analysis of loose coupling in the four years after NASA’s ERP implementation (Appendix C). Rather than focus on the causes of loose coupling, this study addressed the forms and effects of loose coupling in ERP-related business processes, which involved being precise about the dimensions of loose coupling (Beekun & Glick 2001) and the aspects of practices (Volkoff et al 2007) across which business processes are loosely coupled. Through an analysis of 110 interviews spanning more than four years, we found that loosely coupled activities appear to become stabilized over time, and while this stability appears to undermine local imperatives for integration and control at the level of local activities, it enables the enterprise system implementation to stabilize, as well. This enterprise system stability then allows for certain forms of integration and control at an overall process level. Thus “stability” appears to be as important a goal
for enterprise system implementation as the well-established objectives of integration and control. Unresolved misalignments may reach stable states of loosely coupled equilibrium which enable this stability, and need not always be resolved through “alignment.” Based on these findings, we conclude with the counter-intuitive argument that a tightly coupled enterprise system can, in practice, be a mechanism for loose coupling, enabling legitimatization and tight integration on an organizational level, while allowing a space for less-than-complete levels of integration and control for locally situated actions.

1.4 Central Argument

The fundamental thread that runs through the three projects involves the exploration of the relationship among three different concepts: (1) institutional logics, (2) loose coupling, and (3) enterprise systems implementation. In particular, the first two studies involve an effort to theorize about the causes of loose coupling in an enterprise system implementation, and through the theoretical device of “institutional logics” point to the salience of institutional pluralism (Kraatz & Block 2008). Based on this research, it is my assertion that by identifying the specific institutional logics that guide incumbent organizational practices, it is possible to discern whether these logics are congruent with that of a newly introduced information system, and thus predict or explain situations where practice remains loosely coupled with a newly introduced system. The third project involves an exploration of the precise forms and outcomes of loose coupling in the context of enterprise system implementations. Taken together, my overall argument is as follows:
1. Organizations are institutionally plural social structures, that is, they are awash in multiple, often conflicting institutional logics that guide various organizational practices;

2. This institutional plurality is maintained by the loose coupling of certain organizational structures and activities;

3. Enterprise systems such as ERP align with the institutional logic of managerial rationalism, which embodies the principles of tightly coupled mechanistic organizing such as integration and hierarchical control;

4. Enterprise systems are implemented across practices whose institutional logics are often congruent with the institutional logic of the system, and in such cases authentic alignment (after some adaptation) is quite possible;

5. However, especially as the boundaries of enterprise processes can always be expanded, enterprise systems will inevitably be introduced into domains whose practices are guided by institutional logics that conflict with that of the enterprise system;

6. Situations where the institutional logics guiding local practices are incongruent, or conflict, with the institutional logics associated with the enterprise system will often result in the loose coupling of those practices with the enterprise system;

7. Enterprise systems implementations will inevitably involve some form of loose coupling between practices and the enterprise system;

8. The loose coupling between practices and the enterprise system can take multiple forms and can be enabled by variety of mechanisms;

9. Different forms of loose coupling will often undermine the integration and control of activities at an intra-process level of analysis;

10. Loose coupling that reaches a stable state of loosely coupled equilibrium over time promotes stability in an enterprise system implementation;

11. A stable enterprise system implementation, maintained by loose coupling on a local activity level, can enable greater integration and control on an overall process level;

12. Thus stability is an important principle associated with enterprise systems;

13. Further, an enterprise system can act as a mechanism that enables loose coupling, as it provides a neatly ordered appearance on the organizational level that is necessary for legitimacy as well as genuine broad resource control.
Presentations of the studies, associated data, and findings to support these arguments are presented in the appendices and will not be duplicated in the body of this text. However, a review of relevant literature that is more in-depth than that presented in any of the appendices is presented in Sections 2 through 8. In Section 9, I present specific findings of from each project and synthesize these findings in an overall model, and then I address limitations and contributions of this research. The appendices contain drafts of each of the three papers that comprise the heart of this dissertation: (A) the qualitative meta-analysis and institutional framework; (B) the grounded study of institutional logics and loose coupling in NASA’s ERP implementation; and (C) the grounded study of dynamics and consequences of loose coupling in NASA’s ERP implementation over time.
Chapter 2  Institutional Theory

In general, institutional theory stands in direct contrast to functionalist or rational-actor conceptualizations of organizations (Powell & DiMaggio 1991; Scott 2008; Barley & Tolbert 1997; Orlikowski & Barley 2001). Such “atomistic” views simply do not reflect empirical organizational reality, and institutional theory seeks to rectify this by emphasizing the historical, social contexts within which organizational action takes place (Powell & DiMaggio 1991). Organizational action is enmeshed within a broader context of established, persistent institutions that continually reproduce themselves and guide action. Examples of these institutions include marriage, wage labor, the contract, the corporation, etc. (Jepperson 1991). Because of the variety of institutions associated with a given organization are numerous, persistent, and powerful, institutional explanations of organizational phenomena tend to focus on historical and cultural explanations, rather than rational choice arguments.

Institutionalist thinking has been evident for well over a century, and can trace its roots to Durkheim’s observation of “social facts” (Powell & DiMaggio 1991). However, institutional theory experienced a rebirth in the 1960s and 1970s, and is now often described as “the new institutionalism” (Powell & DiMaggion 1991; Scott 2008). Institutional theory is by no means a singular, consistent body of theory – there are a variety of institutional perspectives across disciplines.
2.1. Overview of Institutional Perspectives

New institutionalist thinking can be found in economics, political science, and sociological traditions (Powell & DiMaggio 1991; Scott 2008), and can be grouped into three fundamental paradigms, or “pillars”: the regulative, normative, and cognitive pillars (Scott 2008). Each of these pillars emphasizes different aspects of institutions in society.

The regulative pillar of institutional theory emphasizes the formal, explicit rules and laws that are often enforced coercively in a society. The economic tradition of organizational research (e.g., Williamson 1975; North 1990) often focuses on the regulative pillar with its concern over the impacts of government regulation, for example (Scott 2008). The normative pillar of institutional theory, on the other hand, addresses the often less explicit values and norms associated with appropriate action. Political traditions in organizational analysis (e.g., March & Olsen 1984) often highlight the normative aspects of institutions such as behaviors associated with specific roles in bureaucratic organizations (Scott 2008). The cognitive pillar, on the other hand, is concerned with human meaning-making, and emphasizes symbolic frameworks and social constructions. Sociological streams of organizational research (e.g., Meyer & Rowan 1977; DiMaggio & Powell 1983) often leverage the cognitive tradition of institutional theory in their analyses of varying group interests and perspectives (Scott 2008).

The “cognitive,” or sociological view of institutions can be distinguished from other views in a number of ways. First, a wide variety of practices are
“institutionalizable,” from micro-level actions such as a handshake to the “myths” of progress worldwide (Powell & DiMaggio 1991, p.9). Second, while the other views typically assume certain goals, preferences, interests, and values as given, the cognitive tradition roots individual interests within the historical and cultural contexts of the individuals and the institutions that are part of their experience (Powell & DiMaggio 1991).

Both of these distinctions relate to the study of the responses to enterprise system implementations (respectively) as (1) the local practices that idiosyncratically appropriate the system vary in their scope, and (2) different organizational groups often draw upon distinct institutional arrangements, and thus maintain inconsistent goals, interests, perspectives, etc. Therefore, I have deemed the cognitive view of institutions to be most appropriate for my analysis.

2.2. The “Cognitive” New Institutional Perspective

What Scott (1995) has dubbed the “cognitive pillar” of institutionalist thinking stems from seminal works by Meyer & Rowan (1977) and DiMaggio & Powell (1983), and finds its roots in classic sociology and anthropology literature (phenomenological and ethnomethodological streams), as well as modern theorists such as Berger & Luckman (1967), Giddens (1984), and Bourdieu (1977). This view stresses the “centrality of cognitive elements of institutions: the rules that constitute the nature of reality and the frames through which meaning is made” (Scott 2008, p.40). In the cognitive view, interests are not taken as “given” and symbol systems assume a central position.
In organizational literature, institutions have often been equated with either non-profit or governmental organizations, laws or rules imposed on an organization by government bodies, or as the environment itself, which is comprised of “institutional forces” (Zucker 1987). While these examples capture a portion of the cognitive view of institutions, none quite capture the essence. For example, for-profit organizations are subject to institutional forces from within as well as outside, and non-profits can be a mix of institutional arrangements as well as other forms of arrangements. An organization’s environment can contain institutional forces, but also other forces as well, such as natural disasters and other exogenous disruptions.

Instead, to situate their notion of institutions in relation to the persistent social structures experienced by human actors, the cognitive view emphasizes the way in which individuals interpret institutions and enact those institutions through their practices. Powell and DiMaggio (1991) point to Jepperson (1991) as a source for a careful definition of an institution consistent with this perspective.

2.3. Definition of “Institution”

Following Jepperson (1991), an institution can be regarded simply as “an organized, established, procedure” (p.143). The term “organized” implies structure, and “established” implies history and persistence of the procedure. This procedure, when reproduced consistently, describes a specific social order or pattern that guides the actions of individuals through their rule-like qualities, and from which individuals establish their identities and draw upon to maintain identities (Jepperson 1991). Institutional procedures, or patterns of activity, produce and are
dependent on “symbol systems” which individuals leverage to “categorize that activity and infuse it with meaning” (Friedland & Alford 1991, p.232).

Institutions are conceived to be relative to particular contexts and level of analysis (Jepperson 1991). Jepperson (1991) identifies a wide variety of institutions by name to illustrate the variety of levels and forms that institutions are manifest, for example the handshake, voting, the motel, and the academic discipline can each be considered an institution in themselves, given the appropriate context. Therefore, institutions are nested within each other – from individual micro-practice to “supraorganizational patterns of activity” – and these institutions can be complementary or contradictory with each other (Friedland & Alford 1991).

2.4. Institutional Theory Applied

Institutional analyses typically view institutions as exogenous forces acting upon individual organizations or organizational fields (Scott 2008). The seminal article by DiMaggio and Powell (1983) is an example of this tendency. They sought to explain the why organizations faced with similar pressures will resemble each other, or be “isomorphic.” They asserted that isomorphic organizational changes are responses to coercive and normative pressures of external institutions, as well as through the mimetic processes, or “modeling,” borne of uncertainty. This institutional isomorphism is a prevailing theme throughout institutional research – and is applied to domains as diverse as the diffusion of process improvement efforts across U.S. hospitals (Westphal et al 1997), the spread of environmentalism across chemical companies (Hoffman 1999), institutional explanations of consistent
financial reporting practices across large U.S. companies (Mezias 1990), isomorphism across community health centers (D'Aunno et al 1991), and the particular proclivity for government institutions to respond to isomorphic pressures (Frumkin & Galaskiewicz 2004).

While DiMaggio and Powell (1983) explained organizational change in relation to exogenous institutional pressures, Zucker (1977), on the other hand, demonstrated the persistence of institutional orders in the face of forces for change. Zucker argues that practices can be intentionally institutionalized and thus become quite resistant to change. Subsequent research in this vein includes Galaskiewicz’s (1991) study on the establishing of institutionalized forms of corporate social control in Minneapolis / St. Paul, and an emerging body of literature on “institutional entrepreneurship” (e.g., Battilana 2006; Garud et al 2002; Greenwood & Suddaby 2006; Maguire et al. 2004).

The traditions stemming from these seminal studies (i.e., DiMaggio & Powell 1983 and Zucker 1977) are concerned with consistency – consistency across organizations faced with the same pressure, and the consistency of institutions over time. This consistency is a common thread in institutional analysis, often giving scholars the impression that institutional theory is concerned solely with isomorphism and stability (Lounsbury 2007). Thus, institutional research has been criticized for neglecting institutional change (Scott 2008). One notable exception that details changes in institutional orders is Barley (1986), who describes new
technology as a “trigger” for a structurational process that substantially changes an existing institutional order.

Another common criticism of institutional analysis involves the tendency to view organizations as overly passive in their inability to resist institutional pressures (Oliver 1991; Scott 2008). Oliver (1991) instead proposes a framework of potential organizational responses to institutional forces, and Goodstein (1994) elaborated on this framework (see Chapter 7). Goodrick and Salancik’s (1996) study of the diffusion of cesarean section surgeries across hospitals is a notable example of an institutional study that highlights the active resistance of organizations to institutional pressures.

The final criticism of institutional analysis that I will address involves the general treatment of organizations as singular, homogenous actors. While the bulk of institutional literature focuses on macro-level phenomena concerning industries, sectors, and fields, with organizations as the smallest level of institutional actor, Powell and DiMaggio (1991) caution institutional researchers that any macro-level phenomena can find their roots in micro-level human action.

Of course, when addressing certain society or industry-level issues, it makes sense to address organizations as “homogenous, internally isomorphic” actors (Crouch & Farrell 2004, p.32). However, when addressing issues within individual organizations, a richer institutional view of organizations is typically in order (Friedland & Alford 1991). While some organizations can evolve to institutional status in and of themselves, many do not (Scott 2008). Still, organizations are
typically portrayed as uniform, singular entities in institutional theory, while organizations are in fact typically made up of many fragmented, contradictory, and incoherent patterns of activity (Kraatz & Block 2008; Bacharach et al 1996; Crouch & Farrell 2004; Whitford 2005; Lounsbury 2007). These inconsistent institutional practices coexist within the same organization by being isolated or “decoupled” from each other (Meyer & Rowan 1977; Kraatz & Block 2008).

My view of the institutional context associated with an enterprise system implementation will attempt to take each of these criticisms seriously. Institutions should be thought to persist over time, yet be subject to change. Institutions can apply isomorphic pressures upon local practices, but there are a number of response strategies available to those local practices. Also, while an organization can be institutionalized over time, an organization can typically be thought of as a nexus of multiple, often conflicting institutional practices; as institutionally plural. This set of assertions forms the foundation for my view of institutional logics within organizations.
Chapter 3  Institutional Logic

Individuals within organizations draw upon a variety of institutions to guide their actions, and the construct of “institutional logic” provides a link between macro-level institutions and micro-level action (Thornton & Ocasio 2008). Each institution can be said to have its own “institutional logic,” or guiding principles, assumptions, and symbolic constructions (such as language) that institutional actors draw upon to direct their actions and form their identities in a given domain (Friedland & Alford 1991). Friedland and Alford (1991) argue that institutions can be studied on three levels – individuals, organizations, and society. While institutions are typically conceptualized at the societal level, these institutions are continuously reproduced by individual human actions that are, in turn, reflected in organizational activity. The logic of the institution permeates and remains consistent across these three levels of analysis, and thus is a useful “mediating concept” to address the relationship of specific human practices with society’s broader institutions (Friedland & Alford 1991, p.242).

DiMaggio (1997) indicates that the concept of institutional logic is consistent with the micro-level concept of “logics of action.” A “logic of action” is an “implicit relationship between means and ends underlying the specific actions, policies and activities of organizational members. While the logic of action is for the most part taken for granted, it becomes manifest when parties try to explain to themselves or justify to others the selection of specific means, ends, and the linkage between the
two” (Bacharach et al 1996, p.478). DiMaggio (1997) indicates that the device of institutional logic / logic of action is useful to researchers for the following reasons:

The notion of logics is immensely appealing. First, it proposes that external rituals and stimuli interact with internal mental structures to generate routine behavior. Second, it is consistent with the view that culture is fragmented among potentially inconsistent elements, without surrendering the notion of limited coherence, which thematization of clusters of rituals and schemata around institutions provides. Third, it provides a vocabulary for discussing cultural conflict as confrontation between inconsistent logics of action. (DiMaggio 1997, p.277)

This idea of conflict that “erupts from the clash of institutional logics,” (DiMaggio 1997, p. 277) is central to my analysis. Individuals can be expected to cling to the institutional logics that have guided their actions over a specific domain and imbued these actions with meaning. These individuals cannot be expected to easily move to new, conflicting, institutional logics. When presented with a the force of a new, conflicting, institution, for example, in the form of prescriptions from upper management, organizational actors can be expected to experience dissonance that makes exchange between groups difficult (Bacharach et al 1997). To address this dissonance, local actors have a number of potential strategies in responding to the forces associated with new institutional logics (Townley 1997), and this understanding of dissonance and conflict is essential to my framework on reactions to a new information system. Before addressing these reactions, however, I will briefly review the literature on institutional logics, discuss some related concepts, and present my operationalization of the concept.
3.1. Review of Literature on Institutional Logics

An institutional logic is something that can be induced from the institution and the manner in which individuals relate to that institution. As a fundamental component of institutional orders, logics are constructions that can be used to interpret, compare, and contrast institutional forces (Thornton & Ocasio 2008). Logics help to clarify issues related to institutional persistence and diffusion, particularly themes those associated with conflict and resistance (Townley 1997).

Since Friedland & Alford’s (1991) introduction of the concept of institutional logic, the concept has taken root in analyses of organizational responses to institutional forces, and in the past decade there has been an increasing amount of attention given to the institutional logics. Empirically, this analysis typically takes the form of assessing the impacts of a “dominant” logic in an institutional field, or in investigating the transition from one dominant logic to another across a set of organizations (Lounsbury 2007). Often this shift takes the form of moving from a professional or craft-based logic, to one that is tuned more to market-oriented concerns. Examples of such analyses are evident in a variety of contexts, including the health care industry (Scott et al 2000; Kitchener 2002), the publishing industry (Thornton & Ocasio 1999; Thornton 2001, 2002), British universities (Townley 1997), and symphony orchestra critique (Glynn & Lounsbury 2005).

Friedland & Alford’s (1991) view of institutional logics, however, involved a multiplicity of institutional logics that are coexisting with each other yet often in conflict. This multiplicity is generally not addressed by the wave of literature that
has adopted the device of logics (Lounsbury 2007). However, some empirical research does exist that studies coexisting yet conflicting institutional logics, in contexts such as the mutual fund industry (Lounsbury 2007); the legal profession (Suddaby & Greenwood 2005); regional banking (Marquis & Lounsbury 2007), and a Canadian government agency (Townley 2002). These studies show how conflicting logics are physically (geographically) separate in their practice (Lounsbury 2007), comprised of distinct rhetorical practices (Suddaby & Greenwood 2005) and rationalities (Townley 2002), and result in novel forms of organizational resistance (Marquis & Lounsbury 2007; Townley 1997). With few exceptions (e.g., Kraatz & Block 2008; Bacharach et al 1996), coexisting institutional logics and their impacts within organizations and manifest in individual human action are not addressed in the literature. Thus the “link between micro and macro levels of analysis” that Powell & DiMaggio (1991, p.25) identified as a key area of future exploration for institutional theory continues to go unaddressed in the literature.

### 3.2. Definition of “Institutional Logic”

An “institutional logic” has been described as follows:

> [The logic associated with an institution is] a set of material practices and symbolic constructions – which constitutes its organizing principles and which is available to organizations and individuals to elaborate... These institutional logics are symbolically grounded, organizationally structured, politically defended, and technically and materially constrained. (Friedland & Alford 1991, p.248-249)

It is important to stress that these logics can be fiercely defended, as institutional logics are fundamental components of individual identity: “The routines of each
institution are connected to rituals which define the order of the world and one's position within it, rituals through which belief in the institution is reproduced." (Friedland & Alford 1991, p.250) While Friedland & Alford (1991) focus on institutional logics of broad, societal level institutions (i.e., capitalism, the state, democracy, family, religion, science), the same construct can be applied to the taken for granted, micro-level logics that guide action (Thornton & Ocasio 2008).

### 3.3. Similar and Related Concepts

The theoretical device of an institutional logic bears resemblance to a variety of other concepts. Powell & DiMaggio (1991) indicate that institutional logics are fundamental to the practical reason that directs and enables meaningful human action. They indicate that these logics correspond to Bell’s (1973) notion of “axial principles,” and draw heavily on Bourdieu’s (1977) concept of “habitus.” Thus, Bourdieu’s (1990) “logic of practice” directly equates to institutional logic, and the notion of “logics of action” also compares favorably to institutional logics (DiMaggio 1997).

Scholars have identified a number of concepts that are quite similar to institutional logics, including Weber’s “rationalities” and “value spheres” (Townley 2002; Glynn & Lounsbury 2005); Clegg’s “modes of rationality” (Lounsbury 2007); March & Olson’s “logic of appropriateness” (Blatter 2003); Giddens’s “rationalization of action” (Bacharach et al 1996); Boltanski and Thevenot’s “modes of justification,” and Fligstein’s “conceptions of control” (DiMaggio 1997). Beyond these, I have found that Foucault’s (1972) “regimes of truth” is quite consistent with the notion of
institutional logics. Institutional logics also invoke images of tacit knowing (Polanyi 1966), paradigm (Kuhn 1970), and worldview (i.e., weltanschauung; Weber 1964; Churchman 1971).

It is not within the scope of this discussion to compare and integrate each of these concepts. Instead, each is presented to illustrate the usefulness and generalizability of this concept of logics. Further, I adopt the specific notion of an institutional logic not under the assumption that this is a new, unique, or revolutionary concept, but rather, as a useful vocabulary for identifying the relationship between individual practices and broader society-level institutions within the contemporary organizational discourse that leverages institutional theory.

3.4. Operationalization of Institutional Logic Construct

In order to operationalize the concept and appreciate the clash of incongruent logics, I infer the following four dimensions of an institutional logic that have been recognized in the literature (Table 1). First, institutional logics act as organizing principles that guide activities, and thus embody the goals and values of the institution (Friedland & Alford 1991; Thornton 2002; Townley 1997; Thornton & Ocasio 2008). Second, institutional logics are founded on assumptions associated with specific causal means-end relationships (Friedland & Alford 1991; Bacharach et al 1997). Third, institutional logics are drawn upon to form individual identities (Friedland & Alford 1991; Dimaggio 1997; Jepperson 1991; Thornton 2002; Townley 1997; Thornton & Ocasio 2008). Fourth, institutions are more and less

### Table 1. Dimensions of institutional logic

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Definition</th>
<th>Source</th>
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<tbody>
<tr>
<td>Principles</td>
<td>Goals and values of the institution</td>
<td>Friedland &amp; Alford 1991; Townley 1997; Thornton &amp; Ocasio 2008</td>
</tr>
<tr>
<td>Assumptions</td>
<td>Understanding of causal means-end relations</td>
<td>Bacharach et al 1997; Friedland &amp; Alford 1991</td>
</tr>
<tr>
<td>Identity</td>
<td>Individual or group identities implied by practices guided by the institution</td>
<td>DiMaggio 1997; Friedland &amp; Alford 1991; Jepperson 1991; Thornton &amp; Ocasio 2008; Townley 1997</td>
</tr>
<tr>
<td>Domain</td>
<td>Context or specific practices associated with the institution</td>
<td>Powell &amp; DiMaggio 1991; Jepperson 1991</td>
</tr>
</tbody>
</table>

By leveraging this operationalization of the concept of institutional logic, it is possible to compare institutions and determine whether they conflict. For example, institutions associated with different domains will likely not conflict. However, if institutions are relevant to the same domain, yet have irreconcilable principles and guiding assumptions, or the identities that individuals draw from these institutions are not equivalent, there is likely to be conflict. This notion of domain is critical to understanding conflicting institutional logics. In situations where organizations are the unit of analysis, this domain is typically defined in terms of an institutional field or industry. However, in intra-organizational contexts, domains are determined in relation to the practices of groups and individuals. Next I will briefly address an institutional notion of practice.
This discussion of institutional logics has centered on the principles, values, assumptions, etc., of institutional practices. This notion of practice is critical to my exploration of conflicting institutional logics, because a practice represents the domain of an institutional logic. If two inconsistent logics address different domains, there is not likely to be conflict. If, however, inconsistent logics address the same domain (i.e. they guide the same practice), then there will likely be conflict. First, I briefly address Bourdieu and Giddens from Powell and DiMaggio’s perspective, and then I define what I mean by institutionalized practice in an intra-organizational domain, and briefly describe how these practices relate to business processes.

4.1. Bourdieu & Giddens

Powell and DiMaggio (1991) adopt a structurational view (Giddens 1984) of the recursive relationship between broader institutional structures and individual human actions. However, they indicate that Giddens does not adequately articulate why individuals act the way they do, beyond “adherence to routine” and “the compulsion to avoid anxiety” (Powell & DiMaggio 1991, p.23). To address this concern, they draw upon Bourdieu’s (1977) notion of *habitus*, to describe internalized, generative rules, or dispositions, that are chronically reproduced by individuals through everyday action, as the foundation for conceptualizing
institutions. These rules are taken for granted, self-evident, and doxic, based on “tacitly assumed presuppositions” (Bourdieu 1977, p.3):

The habitus is the universalizing mediation which causes an individual agent’s practices, without either explicit reason or signifying intent, to be none the less “sensible” and “reasonable.” The part of practices which remains obscure in the eyes of their own producers is the aspect by which they are objectively adjusted to other practices and to the structures of which the principle of their production is itself the product. (Bourdieu 1977, p.79)

Thus the cognitive tradition emphasizes the non-explicit structures that guide human action. Habitus is the device used to capture the “practical, semiautomatic, noncalculative nature of practical reason” for Powell & DiMaggio, and more deeply explains the motivation for Giddens’s “knowledgable agents” to continually reproduce the institutionalized structure (Powell & DiMaggio 1991, p.26). Therefore, in the vocabulary of structuration (Barley & Tolbert 1997), while the other pillars of institutional theory are concerned with domination (formal rules & explicit power, i.e. regulative) and legitimation (norms & sanctions, i.e. normative), cognitive institutional theorists emphasize the primacy of institutional signification, which is concerned with actions and their relationship with human interpretation.

By adopting this view, I take as the primary driver of practice the dispositions of individuals in aligning with particular logics, rather than any explicit rule or normative assumptions of their immediate contexts. Logics take a prime position in the manner that individuals approach their activities and routines – if the formal rules or norms are inconsistent with this logic, they will likely be avoided or in some way not reflect actual activity.
4.2. Definition of “Practice”
Simply put, institutionalized practice can be described as “programmed actions” (Berger & Luckman, p.75). However, this programming does not come through rules and norms, but from the experience associated with historical repetition. From a structurational viewpoint, routinized actions and their often unintended consequences are fundamental to the composition of social structure (Giddens 1984). Routines are enacted through “scripts,” which are “observable, recurrent activities and patterns of interaction characteristic of a particular setting” (Barley & Tolbert 1997, p.98). These scripts are the aspect of an institution that is “experienced and analyzable external to the consciousness of individuals” and therefore enact chronically reproduced, self-activating activities (Jepperson 1991, p.143). Thus we have the two key components of an institutionalize practice: (1) the practice must be routinized and (2) the practice has an identity or character that is “external” to the individual.

While all human activity can in some way be described as institutional practice, in relation to one of society’s multiplicity of nested institutions, practices can vary in the degree to which they are institutionalized (Barley & Tolbert 1997). Therefore, institutional practices for any given analysis, are those that are institutionalized enough, with respect to a particular institution, to be analyzed.

4.3. Institutions and Business Processes
A definition of practice that includes the term “routinized” may imply work that is not challenging or “routine,” which is problematic. As Pentland and Reuter (1994)
indicate, as a noun, the word routine implies “recognizable patterns of action,”
which is consistent with that of Nelson & Winter (1982). However, as an adjective,
routine implies repetitive and mindless work. Pentland found, however, that
routinized structures that he deems “grammars,” were quite consistent even across
non-repetitive professional work. He found that the term “process” is a suitable and
less value-laden alternative to the term “routine”:

*Processes can be more or less repetitive, more or less automatic, embody more or
less variety, search, and so on. From this perspective, an organizational routine
need not be especially "routine," (Pentland & Reuter 1994, p.491)*

Following Pentland’s (1995) thinking, business processes are the fundamental class
of institutionalized practices within organizations. In fact, in Pentland’s later work
(Feldman & Pentland 2003) routines are a force for change, rather than the stability
they often imply – an observation that mirrors the discourse on institutional
isomorphism and conflict.

As Pentland (1995; Pentland & Reuter 1994) indicates, business processes are
certainly routinized in a structurational sense, but they also meet the other criteria
of an institutionalized practice in that they are external to any given individual and
certainly have the flavor of self-activation. A look into any of the numerous modern
“process-focused companies” (Hammer 1996), or any organization undergoing an
ERP implementation (Markus & Tanis 2000), and one can easily see the reification
of the business process. For the purposes of this analysis, named business
processes are the institutionalized practices – the domains of the institutional logic
– of interest.
In the preceding sections, I have rooted my view of institutions in the cognitive
tradition of institutional theory, thereby allowing for the position of primacy that I
argue institutional logics to take across institutional practices, or in this study,
business processes. Next, I briefly address the key concepts associated with the
rationalization of business processes, then, in Chapter 7, I leverage recent
theoretical advancements in the study of business processes (i.e., organizational
routines) to operationalize the concept (see Section 7.3).

4.4. Rationality and Rationalization

A common theme across many institutional analyses of organizational practices
involves the degree to which those practices are “rationalized.” For example,
DiMaggio & Powell (1983) invoke Weber’s iron cage of rationalization through the
bureaucracy as a form of “collective rationality.” Widespread adoption of the
bureaucracy as the primary organizational form across organizations results from
individual attempts to be rational: “individual efforts to deal rationally with
uncertainty and constraint often lead, in the aggregate to homogeneity in structure,
culture, and output” DiMaggio & Powell 1983, p.148). Thus DiMaggio & Powell
(1983) artfully maneuver between two forms of the rational: a standardized
organizational form (i.e., rational social structure) and individual attempts to act
based on reason (i.e., rational behavior). The first can be described as
“rationalization,” the second as “rational action,” next I briefly address each in turn.

Weber’s view of rationalization, when applied to a bureaucracy, was clearly calling
for a particular form of rationality in guiding organizational structures: a technical
rationality untainted by political maneuvering, individual personalities, and corruption (Clegg et al 2006). In this sense, rationalization is the intentional construction of organizational practices as instruments as a means for legitimate authorities to act through to accomplish their goals. Rationalization describes the process through which organizational practices are standardized, depersonalized, made explicit, and technically driven.

Rational action, on the other hand, is a term used to describe the reasonable, well thought-out, or logical cognitive processes by which individuals devise the means for action. Since no human is capable of perfect rationality due to human limitations, rational action is often characterized in terms of “bounded rationality” (Simon 1957). Nevertheless rationality describes the individual cognitive activity, whereas rationalization describes the organizational process. Therefore, one might irrationally rationalize an organizational process, if one were to unreasonably attempt to standardize and depersonalize that process.

This distinction is important, since specific actions that draw upon diverse institutional logics might rationally be consistent with their respective logics yet appear quite different from each other. There is no universal, singular rationality for action where there are a variety of institutional logics. However, the term rationalization is used to describe the specific activity associated with the bureaucratization of organizational activities. With this distinction in mind, next I will address the situation where societies pluralistic array of institutions come into conflict.
Institutional theory has long been criticized for emphasizing stability, passivity, and isomorphism with a blind eye to change and heterogeneity (Scott 2008; Oliver 1991). With emerging popularity of the device of institutional logics, however, institutional researchers are increasingly addressing issues such as institutional change and resistance to institutional pressure (Marquis & Lounsbury 2007; Townley 1997). As indicated above, however, this theorizing generally treats organizations as homogenous, single actors, when, in fact, organizations are awash in multiple, often conflicting institutions (Kraatz & Block 2008).

5.1. Responses to Conflicting Institutions

In their seminal work, Meyer and Rowan (1977) indicate that highly institutionalized organizations are those that are not concerned solely with rational efficiency, but are also under the influence of institutions such as professions, government policies, and traditions. Such organizations persist over time largely by decoupling many activities from rationalized scrutiny. “Organizations built around efficiency attempt to maintain close alignment between structures and activities... but a policy of close alignment in institutionalized organizations merely makes public record of inefficiency and inconsistency” (p.57). Among other practices, highly institutionalized organizations tend to avoid detailed inspection and control, they perform activities beyond the visibility of managers, and coordination is handled informally. Through this decoupling, the messy reality of organizational
activity need not interfere with the “assumption that formal structures are really working... decoupling enables organizations to maintain standardized, legitimating, formal structures while their activities vary in response to practical considerations” (Meyer & Rowan 1977, p.58).

The phenomena that Meyer and Rowan (1977) attribute to highly institutionalized organizations, we now realize applies to every organization to a greater or lesser degree (Brunsson 1989). Organizations are a web of intersecting and often conflicting institutions (Kraatz & Block 2008; Bacharach et al 1996; Crouch & Farrell 2004; Whitford 2005) that can coexist by virtue of their loose coupling. Further, individuals are not passive recipients of institutional forces; instead, they respond to the forces associated with new institutions in a variety of ways (Powell & DiMaggio 1991; Scott 2008; Oliver 1991; Goodstein 1994; Goodrick & Salancik 1996). My fundamental argument is that individuals and groups who are presented with institutional logics that conflict with the logics that guide their action, they will reconcile their activity with these conflicting logics by loosely coupling their practice from the new institution.

5.2. Definition of “Conflicting Institutional Logics”
Within organizations, I anticipate the presence of incumbent institutional logics in local practices that are incongruent to that of the ERP system. Unlike the global organizing logics of contemporary organizations, these local practices may not be motivated by concerns of efficiency or control (Wenger 1998). They may not align well to standardization and integration, may resist rationalization, and may
generally be less routine (the adjective form of the word). Oliver’s (1991) notion of consistency applies here, as she indicates that inconsistent institutions have different goals, and compliance with an inconsistent institution would reduce an organization’s decision making discretion, and thus effectiveness. Goodstein’s (1994) notion of “congruence” is concerned specifically with the goals and policies of the new institution, and if they can be accommodated while maintaining faithfulness to the goals and practices of the organization. DiMaggio (1997) thinks of conflicting logics as inconsistent cognitive schemata that are simultaneously applied to the same situation. As an indication of conflicting logics, Bacharach et al (1996) emphasize the “dissonance” that is felt by organizational actors in such cases that limits their ability to continue established practices. Based on Oliver (1991), Goodstein (1994), DiMaggio (1997), and Bacharach et al (1996), I can conceive of two situations, where institutional logics can be congruent (1) the potentially inconsistent logics are applied to different domains, and thus never conflict; or (2) two or more institutional logics can be applied to the same practices, and those practices can be guided by these logics without the dissonance. Thus, I define incongruent institutional logics as those that are applied to the same domain and situation and cannot simultaneously guide the practices without fundamentally changing those practices. Incongruent logics can coexist by virtue of their loose coupling.
Chapter 6  Loose Coupling

Loose coupling is perhaps the most vital concept to this set of studies, but it is an often misunderstood and haphazardly used concept (Orton & Weick 1991) and therefore should be explored with thoroughness and care. The notion of loose coupling finds its roots in the “open systems” tradition of systems theory, as opposed to the rational systems tradition that, according to Weick (2002), is only recently beginning to lose favor as a model for organizational theory. The rational systems tradition maintains a formal, mechanistic, and bureaucratic portrayal of organizations; whereas the open systems tradition of organizational theory characterizes organizations as systems that are comprised of semiautonomous parts that vary in their responsiveness to each other, and that operate in environments of distributed decision making, complexity, and variability (Scott 1987).

Weick (1976) is largely credited with bringing the term “loose coupling” into the organizational discourse, and he, in turn, credits Glassman (1973). However, the characterization of organizations as loosely coupled subsystems predates their use of the idea under names such as near decomposability (Simon 1996), nonseparability (Churchman 1971), and degree of conditionality (Ashby 1962). Next I define loose coupling, review the related organizational literature, present Orton & Weick’s (1990) theory of loose coupling, and present five dimensions of loose coupling to guide analysis using the concept.
6.1. Definition of “Loose Coupling”

Loose coupling refers to patterns of action that are distinct, or separate from each other, yet are still responsive to each other in some fashion (Orton & Weick 1990). Loose coupling is a dialectic concept intended to offer an alternative to both tightly coupled and decoupled system concepts. Tightly coupled systems are highly integrated and responsive to each other, while non-coupled systems are completely separate and unresponsive (Orton & Weick 1990). It is important to note, however, that loose coupling does not imply a midpoint on a continuum with non-coupling on one end and tight coupling on the other, as is often implied by the term (Brusoni & Prencipe 2001). Rather, loose coupling indicates the presence of both decoupling and tight coupling. For example, in describing an organization as “loosely coupled,” one may merely indicate that there is tight coupling between certain groups and practices, and non-coupling between others. Loose coupling implies the simultaneous coexistence of both rationality and indeterminism at points across an organization (Orton & Weick 1990).

Loose coupling is adaptable to multiple levels of analysis (technical, conceptual, social, organizational, supra-organizational, etc.) and can be used as a construct in support of multi-level theorizing (Orton & Weick 1990). The notion of loose coupling is evident in a wide variety of organizational literature.

6.2. Loose Coupling and Organizational Literature

Loose coupling is used in studies across disciplines and theoretical positions, and can be used as both a dependent and independent variable (see Orton & Weick 1990
of a review). Of particular note is the way loose coupling pervades much of the classic management literature, often in the form of explicit arguments relating to the phenomena related to loose coupling within organizations. For example, in the domain of organizational decision making, problems, solutions and decision makers can be fairly independent, coming together in periodic decision situations (Cohen et al 1972). Actions have been found to be loosely coupled to plans and intensions (Weick 1976), as well as to the justification of those actions (Salancik & Pfeffer 1978). The multiplicity of goals and preferences evident in organizations can be loosely coupled across individuals and groups, and also within the same individuals and groups across time and across contexts (March 1978). Further, due to limitations of managerial attention and rationality, organizations remain loosely coupled to their environments (Pfeffer & Salancik 1978).

Classic management research into organizational structures also explicitly attends to issues relating to the loose coupling of elements within organizations and the relationship between loosely coupled organizational forms on outcomes such as survival (Hannan & Freeman 1977), flexibility (Mintzberg 1979), and innovation (Daft 1978). The notion of loose coupling is consistent with classic contingency theories of organizational structures that viewed organizations as partially independent subsystems (Simon 1996). These subsystems can be loosely coupled over the hierarchical elements of an organization and its environment (ala Thompson 1967), the functional elements of an organization (ala Lawrence & Lorsh 1967), or simultaneously across both the hierarchy and the functional groupings (Galbraith 1977). Thus it is quite consistent with classic management theory to view
organizations as comprised of subsystems which vary in their degree of loose and tight coupling with each other (Scott 1987; Weick 1979).

Further, the notion of loose coupling is arguably central to economic organizational theories, as well. Transaction cost theory (Williamson 1975) involves an explanation for the existence of firms involving the loose coupling of different parties through transactions. In the domain of economic discourse on modularity, modularity has been explicitly equated with loose coupling (Baldwin & Clark 2000; Langlois 2002).

Two of the most widespread applications of loose coupling within organizational research are the institutional tradition of Meyer and Rowan (1977) and research into high-reliability organizations (Perrow 1984). In their seminal work on schools, Meyer and Rowan show how educational organizations must satisfy multiple

<table>
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<tr>
<th>Application</th>
<th>Level of Analysis</th>
<th>Description</th>
<th>Outcomes</th>
<th>Tradition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Individual &amp; group practices; monitoring</td>
<td>Loose coupling between the monitoring of the practice and the practice itself. (Ceremonial or partial conformity.)</td>
<td>Partial control: activities different than they appear to monitoring structures.</td>
<td>Meyer &amp; Rowan 1977</td>
</tr>
<tr>
<td>Integration</td>
<td>Organizational units &amp; processes; organizations; environment</td>
<td>Elements linked to each other, but not fully responsive. (Incomplete or modular integration.)</td>
<td>Partial integration: delays and redundancy between elements</td>
<td>Perrow 1984</td>
</tr>
</tbody>
</table>

Researchers vary in their view of the relationship between modularity and loose coupling. Baldwin & Clark equate the two, while Langlois uses loose coupling to describe an imperfect modular relationship. Consistent with Orton & Weick, we would argue that modularity is loosely coupled (distinct and responsive), and that imperfect modularity is more loosely coupled.
incompatible expectations from a variety of sources, and do so by constructing a space between the technical performance of certain activities and the monitoring of these activities. Among other tactics of loose coupling, they indicate that such organizations ceremonially conform to certain expectations in order to give the appearance of compliance and maintain legitimacy. This notion of ceremonial nonconformity has been used to describe “partial conformity,” which is a loosely coupled form of organizational resistance to institutional forces for change (Oliver 1991; Goodstein 1994). Loose coupling through tactics of partial conformity are sources for new, emergent institutional structures (Hallett & Ventresca 2006), as loose coupling provides a “working space” for individual agency between institutional pressures (Seo Creed 2002).

Another classic treatment of loose coupling is Perrow's (1984) work on “normal” organizational disasters, which characterizes organizational structures as either tightly or loosely coupled based on the level of specificity and detail that organizational activities are programmed. Perrow indicates that specific forms of complexity require different forms of coupling, but that there is always a trade-off. Tightly coupled systems are generally more controlled, less flexible, but can be highly efficient in situations where patterns of activity are invariant. Tight coupling is often necessary for certain contexts that have heavily-interactive components. Loosely coupled systems, on the other hand, tend to be rife with slack, buffers and redundancy, and therefore tend to be inefficient, but are highly adaptable to external shocks. Loosely coupled systems are suited to situations where delays are acceptable and patterns of activity are uncertain (Perrow 1984). Subsequent
research into high reliability organizations has found that loose coupling in the form of structural redundancy allows the operational slack necessary for organizational resiliency situations (e.g., LaPorte and Consolini 1991; Grabowski & Roberts 1999). Other forms of loose coupling, such as “conceptual slack” (Rijpma 1997) and the loose coupling of decisions from the formal hierarchy (Bigley & Roberts 2001) have been found to improve certain forms of reliability. However, recent analysis suggests that more complex, tightly structured organizational forms may respond better to crisis in certain situations (Lin et al 2006) and that certain forms of redundancy increase complexity, thus the probability of accidents (Rijpma 1997).

Snook (2000) combines these two approaches to loose coupling in his theory of practical drift. In analyzing the structure of military operations in the context of a crisis – the accidental fire on U.S. helicopters by U.S. forces in Northern Iraq – Snook notes that the loosely coupled form is maintained through tightly coupling the actions of distributed teams to formally designed standard procedures. Over time, he found that localized, practical actions “drift” from standard procedures over time which then contributes to potential organizational failure. Thus he combines coupling along two dimensions: (1) organizational structure, and (2) the coupling of activity with formal procedures, with a temporal dimension, showing that coupling does not remain stable over time, that these dimensions interrelate, and that the emergent outcomes are directly related to organizational performance.

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While Snook’s theory leverages Perrow’s work on coupling in organizational structures, as well as Weick’s conceptual work, it does not explicitly attend to the Meyer & Rowan stream, but the loosely coupled conformity between practice and formal structure is evident.
This combination of tight and loose coupling across a variety of dimensions and over time is also evident in recent literature on innovation. For example, in dynamic, highly innovative contexts, loosely coupled organizational units are adaptively configured into different organizational structures – some tightly coupled and some more loosely - for different projects, over time, and simultaneously within the same organization (Yoo et al 2006; Ciborra 1996). In these contexts loosely coupled knowledge communities maintain coordination through a set of practices and artifacts within “trading zones” which facilitate adaptability, speed, and learning (Kellogg et al 2006) which foster multiple, cascading “wakes” of innovations across multiple dimensions over time (Boland et al 2007). Other examples of various combinations of loose and tight coupling in innovative contexts are evident in other streams of literature, as well (Sanchez & Mahoney 1996; Volberda 1996; Adler et al 1999, etc.).

Thus our review of the concept of loose coupling highlights the power of the concept of loose coupling for making sense of relationships between organizational elements that are linked to each other, but only partially so. However, this review also points to a variety of potential explanations for loosely coupled activity that is evident in organizations. Next we will distinguish between the key assumptions of key streams within each of the three pillars of institutional analysis (regulative, normative, cognitive), as well as the primary body of organizational research that institutional theory is typically set against (i.e., contingency theory).
6.3. Alternative Organizational Explanations of Loose Coupling

As indicated in Chapter 2, the new organizational institutionalism arose in response to the dominant functional view of organizations, often described as “contingency theory” (Donaldson 2001). Further, the cognitive pillar sparked by Meyer & Rowan’s (1977) work was but one of the institutional responses to this dominant view, others included a “regulative” view that emphasized explicit, formal institutions and the other was a “normative” view that emphasized values and roles guiding embedded activity (Scott 2008). Next we will briefly touch upon an example lens from each of these alternative perspectives to establish the applicability of the notion of “logics” in a business process domain.

<table>
<thead>
<tr>
<th>Tradition</th>
<th>Example</th>
<th>Solution to Conflicting Demands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional</td>
<td>Contingency theory</td>
<td>Separate organizational units</td>
</tr>
<tr>
<td>Regulative</td>
<td>Incentive theory</td>
<td>Principal: abstracting up incentives; Agent: probabilistic behavior</td>
</tr>
<tr>
<td>Normative</td>
<td>Systemic power</td>
<td>Supplant value systems over time</td>
</tr>
<tr>
<td>Cognitive</td>
<td>Institutional logics</td>
<td>Simultaneous collocated coexistence</td>
</tr>
</tbody>
</table>
First, in the contingency view, appropriate organizational structures arise to best fit certain environmental and intra-organizational contingencies. The organizations that best fit their particular contingencies tend to perform better (Donaldson 2001). This view was perhaps most commonly evident in the contingency arguments of organizational structure (i.e., Lawrence & Lorsch 1967; Thompson 1967; Galbraith 1977; see Donaldson 2001 for a review). In a foundational study, Lawrence and Lorsch (1967), for example, argued that organizations in highly uncertain environments required greater differentiation between departments and strong integrative units between these departments to resolve conflict between them. In another seminal work, Thomson (1967) argued that organizational hierarchies varied in the degree to which they buffered the “technical core” of an organization from environments based on the degree of uncertainty of those environments. In both of these analyses, as well as through the bulk of contingency arguments, there is an “optimal” form of organizing based on given internal and external contingencies across organizations. Solutions to conflicting contingencies involve the separation of roles between organizational units, thus the multidivisional form is generally found to be ideal for large complex companies (Donaldson 2001). Based on their organizational level of analysis, contingency arguments do little to recognize the pluralistic organizational contexts and conflicting demands that subunits and individuals face within organizations. The solution for conflicting demands tends to be devised in terms of separating out organizational units in contingency theories.
Another view of organizational action is the “regulative” view, which is often favored by economic analysis of organizations (Williamson 1975, North 1990). As indicated above, transaction cost theory (Williamson 1975) involves an explanation for the existence of firms involving the loose coupling of different parties through transactions in a marketplace. However when explicit contracting and routinization of inter-firm activity is difficult, then firms will integrate those transactions within a single organization. Thus conflicting demands are shielded from the high-powered incentives of the marketplace, and reconciled by the active management of incentives within organizational bounds. Within the organization, agency theory deals with the relationship of simultaneous separation and control between principals and agents (Jensen & Meckling 1976). As organizations exist for the purpose of handling dynamic, unpredictable situations, incentive conflicts inevitably arise, and the problems associated with incompatible incentives is a major difficulty in incentive theory (Laffont & Martimort 2002). Principles often look to encourage the performance of multiple incompatible tasks, and can manage this through explicitly contracting each task (Laffont & Martimort 2002), or by broadly incentivizing a variety of activity simultaneously and less explicitly (Holmstrom and Milgrom 1991). However, agents must also navigate a variety of incentive constraints, and oftentimes these incompatible tasks are so contradictory (i.e., they satisfy the monotone hazard rate property, Laffont & Martimort 2002) as to preclude simultaneous contracting. Further, principals must deal with diverse individual utility functions. From an economic perspective, conflicting demands are reconciled at an individual agent level, and resulting behavior is a function of
incentive contracts, incentive constraints, and utility functions. Thus the economic, or regulative, perspective potentially offers insight into the resulting loose coupling in specific situations, but does little to explain the embedded patterns of this activity. In economic theory, efficiency, productivity, and economic gain are the values by which behavior is (boundedly) rationally judged.

To deal with the variety of embedded patterns of behavior that may or may not be entirely inconsistent with the assumptions of economic models, normative perspectives on institutionalism highlight the values embedded in pre-existing institutional orders (Scott 2008). This view focuses not only on embedded action, but on the way preferences and interests are established within institutional orders that are politically generated and reciprocally reproduce power structures (March & Olson 1984). An example of such politically-charged view of institutions is evident in the systemic view of power (Clegg et al 2006), where those in power set the agenda, shape individual interests and thereby participation. This view explains the notion of “total institutions” whereby individuals are entirely dehumanized subjects acting in conjunction with an all-encompassing control apparatus (Clegg et al 2006). In such an institutional order, a specific set of values and interests are reinforced, thus making extreme, inhuman acts of violence possible. Such total institutions are extreme examples of systemic power, but serve to illustrate the way in which institutions are implicated in the reproduction of power structures. Within an institutional order, conflicts do not arise, but between these orders, conflicts are resolved by supplanting one political order with another, or by changing a given institutional order in line with changing subjectively determined (evolved) interests.
(Clegg et al. 2006). In the normative view, conflicts do not exist within prescribed practices, as interests are already determined by the institutional order within which the practices are situated.

Only within the cognitive view of organizations is the agency of the regulative view combined with the structures of the embedded institutional orders of society. In this view the interests of individuals are not strictly situated in imperatives of efficiency and productivity, nor are they captive to specific institutional orders of other types. Rather, individuals can adeptly navigate competing institutional orders, drawing upon suitable patterns of behavior when applicable, but also able to make sense of and reconcile alternative patterns when they deem appropriate. The cognitive view recognizes the diversity and nested nature of a society's institutions (Friedland & Alford 1991), as well as the pluralistic patterns of activity within a society. Thus the cognitive view is particularly well-positioned to offer insight into the way conflicting demands are reconciled at individual or group levels, while maintaining ties to overarching institutional orders. In contrast, the regulative (economic) view generally allows for a thorough analysis of one of these institutional orders that prize economic interests. Also, the normative (political) view aids us in understanding the establishment, reproduction, and change of specific institutional orders. Finally, the contingency theory of organizations does not deal with specific actors, nor with the precise mechanisms of change, but emphasizes the overall economic results of different consequences of institutional dynamics as they play out in organizations.
From this analysis, it is clear that the lens one might adopt must be driven by the research question, and in this case the question involves the way individuals reconcile competing institutional logics in the domain of a business process. From this review, however, it is also clear that the notion of loose coupling in each of the perspectives can mean a variety of things – loose coupling is manifest itself in multiple dimensions, across diverse elements, and these relationships may change dramatically over time. Therefore, before continuing to our analysis of loose coupling in the context of NASA’s enterprise system implementation, it is important to be clear about the dimensions we focus on in our analysis and the reasons for this focus.

6.4. The Theory of Loose Coupling

In the “theory of loose coupling” (see Figure 1), Orton & Weick (1990) argue that in an organizational context loose coupling is (1) caused by issues of indeterminacy and fragmentation; (2) takes a variety of forms; (3) each of which have qualitatively different direct effects that, in turn, (4) may be quite different than the organizational effects; and often requires (5) compensatory phenomena to maintain organizational cohesion. Overall, loose coupling is its many forms generally enables local adaptivity, organizational flexibility, and the simultaneous fulfillment of conflicting demands (Weick 2001). These benefits are generally characterized to come at the expense of efficiency and execution in contexts of greater certainty. The theory of loose coupling is rooted in an open systems theory of organizations that
views organizations as collections of subsystems which are partially connected to each other and to their environments (Scott 1987).

Orton & Weick (1990) refer to their treatment of loose coupling in organizations as “the theory of loose coupling” (see figure 1). Yet the theory they propose is more of a structure for theorizing, as the causes, effects, and interactions they discuss are generic and adaptable to a variety of environments. What do the terms “fragmentation” and “buffering” between subsystems mean in all organizational contexts?

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Figure 1. The Theory of Loose Coupling (Orton & Weick 1990)
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The theorizing that that Orton & Weick put forth is not a theory in the traditional measure, predict, and explain sense of the term. Nor is it a grand theory that attempts to encompass universal philosophical or social truths. Rather, loose coupling has been described as a metaphorical lens (Morgan 1980) through which
we can view organizational phenomena. The metaphor of a loosely coupled system was created specifically “to counter the assumptions implicit in mechanical and organismic metaphors that organizations are tidy, efficient, and well-coordinated systems” (Morgan 1980). While such metaphors do not represent theories, in their traditional sense, they can be used to generate such theory. One can legitimately argue that enterprise systems are generally characterized in terms of mechanistic metaphors that involve concepts such as control, integration, and the elimination of misalignments. Therefore, this body of work is ripe for new theory that postulates an alternative or perhaps complementary set of assumptions. The lens of loose coupling affords precisely this set of assumptions, and next we will develop a more precise evaluative framework for the various dimensions through which we can make sense of loose coupled phenomena.

6.5. Dimensions of Loose Coupling

Orton & Weick (1990) suggest five broad consequences of loose coupling: persistence, buffering, adaptability, satisfaction, and effectiveness. Table 4 offers examples of how each of these consequences of loose coupling are evident in recent literature. What is perhaps most evident from these examples is that the loosely coupled elements, context, mechanism by which loose coupling is enabled, and the specific consequences vary widely. Also, many of these broad consequences do arguably overlap. For example, effective knowledge sharing (Ravasi & Verona 2001) implicitly enables adaptation in a hypercompetitive environment.
When applied to a given context, the elements that are loosely coupled, the mechanisms by which they are loosely coupled, and the consequences measured tend to vary. Research into the effects of loose coupling in two contexts, for example - the performance of design teams and high reliability organizations - have found a variety of, often conflicting consequences.

### Table 4. Recent Examples of Consequences of Loose Coupling

<table>
<thead>
<tr>
<th>Consequence of Loose Coupling</th>
<th>Loosely Coupled Elements</th>
<th>Context</th>
<th>Mechanism</th>
<th>Consequences</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness</td>
<td>Organizational Structures</td>
<td>Hyper-competition</td>
<td>Structural Ambiguity</td>
<td>Facilitates learning &amp; knowledge sharing</td>
<td>Ravasi &amp; Verona 2001</td>
</tr>
<tr>
<td>Adaptability</td>
<td>Organization with Customers</td>
<td>Retailers</td>
<td>Relationships</td>
<td>Loose coupling fosters greater sensing &amp; innovation</td>
<td>Daneels 2003</td>
</tr>
<tr>
<td>Buffering</td>
<td>Different functions</td>
<td>Film production</td>
<td>Film director</td>
<td>Directors buffer artistic from production functions</td>
<td>Alvarez et al 2005</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>Professionals &amp; Work</td>
<td>Medical industry</td>
<td>Bureaucracy</td>
<td>Loose coupling enables greater job flexibility and satisfaction</td>
<td>Briscoe 2006</td>
</tr>
<tr>
<td>Persistence</td>
<td>Routines &amp; Accounting Data</td>
<td>Global manufacturing</td>
<td>Managerial activity</td>
<td>Loose coupling enables managerial agendas to coexist / legitimacy</td>
<td>Lukka 2007</td>
</tr>
</tbody>
</table>

- **Design Teams:** In the example of design teams, loose coupling between teams that is mediated by social ties appears to facilitate knowledge search in non-complex projects, but appears to impede knowledge sharing in complex projects (Hansen 1999). Temporal loose coupling, where IT specialists are
not brought in on product designs early, adversely affects these projects through waste, delays, and increased rework (Mitchell & Nault 2007; Mitchell & Zmud 1999). In a context of virtual design teams that are entirely mediated by IT, loose coupling between teams has been found to have an adverse effect on innovativeness (Gibson & Gibbs 2006). In yet another example, tight coupling with IT artifacts, combined with loose coupling between organizations, foster a variety of innovations over time (Boland et al 2007).

- **High Reliability Organizations**: While research into HROs has found that loose coupling in the form of structural redundancy allows the operational slack necessary for organizational resiliency situations (e.g., LaPorte and Consolini 1991; Grabowski & Roberts 1999). Other forms of loose coupling, such as “conceptual slack” (Rijpma 1997) and the loose coupling of decisions from the formal hierarchy (Bigley & Roberts 2001) have been found to improve certain forms of reliability. However, recent analysis suggests that more complex, tightly structured organizational forms may respond better to crisis in certain situations (Lin et al 2006) and that certain forms of redundancy increase complexity, thus the probability of accidents (Rijpma 1997).

In light of often blunt and varied usage of the term and the inconsistency of the reports relating to consequences, when studying loose coupling it is important to be very clear about the elements in question, the manner in which they are loosely coupled, and the consequences of interest (Orton & Weick 1990). To thus
operationalize loose coupling we adapt Beekun and Glick’s (2001) multidimensional framework for loose coupling in organizational contexts along the following dimensions: elements, domains, content, and mechanisms (see Table 5). To these we add a fifth dimension, which is the dependent variable of interest for the analysis.

<table>
<thead>
<tr>
<th>Coupling Dimensions</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elements</td>
<td>“Anythings that may be tied together” (Weick, 1976, p. 5)</td>
</tr>
<tr>
<td>Domains</td>
<td>“The content area of the relationships between coupled elements.”</td>
</tr>
<tr>
<td>Content</td>
<td>“The [content and] quality of the interaction among coupling elements.”</td>
</tr>
<tr>
<td>Mechanisms</td>
<td>“The practices or processes [and artifacts] that enable elements to function together.”</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Dependent variables of interest for the specified domain.</td>
</tr>
</tbody>
</table>

We will use this operationalization to guide our analysis. As the focus of our research involves loose coupling in the context of an enterprise information system implementation, we will review the relevant literature on enterprise systems and loose coupling, develop our analytical framework using institutional theory, and present our findings.

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3 We use the term “content” rather than Beekun & Glick’s (2001) four dimensions (strength, directness, consistency, dependence) as they use those dimensions to capture quantitative aspects of their data, whereas through our interpretive approach, we look to capture more descriptive aspects of the interaction between elements.
Before focusing specifically on enterprise systems, I will briefly develop a framework based on the institutional frameworks of Oliver (1991) and Goodstein (1994), and apply this framework to the literature on the implementation of new information systems in general. Then I will address common notions of alignment, thereby carving a space for my conceptualization of loose coupling with an information technology. After developing an institutional framework for the implementation of new information technologies, I will apply this framework to enterprise systems.

7.1. Institutional Response Framework

Oliver (1991) identified five broad categories of strategic organizational responses to institutional forces (in order of progressively more resistance to the institutional pressure): acquiescence, compromise, avoidance, defiance and manipulation. Goodstein (1994) extended this analysis by indicating that the form of response chosen will be guided by the strength of the institutional pressures combined with the anticipated effect of these pressures on “technical outcomes.”

Inherent in Goodstein’s (1994) analysis, however, is again the assumption that rational action associated with technical outcomes will guide responses universally across all contexts, which is not an assumption consistent with institutionalist thinking (Goodrick & Salancik 1996). Individual discretion in the form of strategic
response is constrained, or “bounded by the institutions that gave rise to it,” and therefore any response to institutional pressure must be consistent with existing institutions (Goodrick & Salancik 1996, p.2). Goodrick & Salancik (1996) remind us that technical outcomes are not always the fundamental concern of organizational activity, as institutions are guided by established norms and values. Based on this insight, I modify Goodstein's (1994) focus on technical outcomes by focusing on congruence of the institutional pressure coming out of new logics with existing institutions. Note that by reinterpreting Goodstein’s (1994) drivers as “congruence,” I am equating this with Oliver’s (1991) notion of institutional “content.” Although Goodstein’s notion of pressure initially appears to embody all of Oliver’s constructs, I choose to focus on “control” as this directly equates to Goodstein’s operationalization.

![Figure 2. Framework of strategic responses to new institutional logics (adapted from Goodstein 1994)](image-url)
My adaptation of the Goodstein (1994) framework leaves room for situations where a rational focus on specific technical outcomes is congruent with the guiding institutional logic, as well as those occasions when it is not (Figure 2).

Following this adaptation of Oliver (1991) and Goodstein (1994), I suggest that when incumbent institutional logics are congruent with that of a newly introduced institution, and the force to comply is great, then local practices will eventually comply with the new institution, or “acquiescence,” which subsumes responses such as habit, imitation, or conformity (Oliver 1991). If, however, this newly introduced institutional logic is incongruent with that of local practice, and yet the force to comply is great, then responses will involve “partial conformity” in the form of compromise or avoidance, which together represent the “thin edge of the wedge in organizational resistance” (Oliver 1991, p.153). These tactics for partial conformity range from “concealing their nonconformity, buffering themselves from institutional pressures, or escaping from the institutional rules or expectations,” to “disguising nonconformity behind a façade of acquiescence...”, “window dressing”; ritualism; ceremonial pretense; or symbolic acceptance of institutional norms, rules, or requirements” (Oliver 1991, p.154). Only if the pressure through which the new logic is introduced is weak can outright resistance strategies, or the “defiance” of ignoring or fighting the institution, be possible. Finally, if the new institution is introduced without a great deal of pressure, yet it is congruent with the logic of existing practice, then the response can involve “manipulation” or control of the newly introduced institution.
My fundamental assumption is that individual and group practices are already invested with institutional logics when new institutional logics are introduced to them. The force with which the new logics, in addition to the level of congruence between the new and existing logics, will affect the response of the group to the new institutional force (Table 6).

<table>
<thead>
<tr>
<th>Response strategies</th>
<th>New institution (adaptation of Goodstein 1994)</th>
<th>Definition</th>
<th>Forms of response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquiescence</td>
<td>Strong pressure; logics congruent</td>
<td>Conformity to institutional prescriptions and implied social order.</td>
<td>Habit (unconscious, passive) Imitation (mimetic isomorphism) Compliance (conscious obedience)</td>
</tr>
<tr>
<td>Compromise</td>
<td>Strong pressure; logics incongruent</td>
<td>“Partial conformity” to explicit institutional prescriptions without necessarily the implied social order.</td>
<td>Balance (parity among multiple interests) Pacify (conform to minimal standards) Bargain (extract concessions for conformity)</td>
</tr>
<tr>
<td>Avoidance</td>
<td>Strong pressure; logics incongruent</td>
<td>“Partial conformity” to either a portion of the institutional prescriptions or none at all.</td>
<td>Concealment (disguise conformity) Buffering (reduce scrutiny, decoupled) Escape (exit domain in which pressure exerted)</td>
</tr>
<tr>
<td>Defiance</td>
<td>Weak pressure; logics incongruent</td>
<td>Non-conformity with a portion of the institutional prescriptions within the applicable domain.</td>
<td>Dismissal (ignore institutional rules) Challenge (actively challenge institution) Attack (intense and aggressive challenge)</td>
</tr>
<tr>
<td>Manipulation</td>
<td>Weak pressure; logics congruent</td>
<td>Actively direct the institutional prescriptions.</td>
<td>Co-opt (take ownership of the source) Influence (“manipulation of belief systems”) Control (“struggles for power”)</td>
</tr>
</tbody>
</table>

The framework synthesizes my discussion of institutional theory and logics, and defines alternative outcomes of information systems alignment vis a vis existing institutional orders. When institutional forces are applied to groups and individuals through the introduction of new logics, the responses of those groups or individuals
will be constrained by the existing institutional logic and affected by both the strength of the new institutional pressure as well as the congruence of the new logic with existing logics. Next I will locate the traditional responses to information technology implementation from the literature within this framework to create an institutional framework for responses to information system implementation.

7.2. Information Systems and Adoption, Adaptation, and Change

The most common terms that information systems researchers use to describe reactions to newly introduced information systems are “acceptance” and “resistance.” Acceptance implies that a new information technology has been adopted by the user (Davis 1989). Resistance, on the other hand, indicates that users oppose the new information system, either through passive avoidance of use or through outright acts of refusal and sabotage (Hirschheim & Newmann 1988). While these are both useful concepts for a variety of purposes, they do not exhaustively represent the richness of potential user responses to an information system. By incorporating the passage of time, for example, early, voluntary acceptance could quickly lead to resistance (e.g., Markus 1983). Similarly, early resistance could evolve into eventual acceptance (e.g., Boudreu & Robey 2005). Perceptions of success and failure change over the life of an information system (Lyytinen & Hirschheim 1988). If a system is used consistently, it must sometimes be modified for use (Leonard-Barton 1988), or the technology is used in unforeseen, improvisational ways (Orlikowski 1996). If a system is resisted consistently, it generally leads to abandonment (LaPointe & Rivard 2005). Table 7 below describes
the potential responses to new information technologies in the literature (in order of increasing resistance).

Thus, from the literature on information systems adoption and adaptation, we have a continuum of responses – from adoption of a system into existing practices, through adaptation, improvisation, resistance, and potential abandonment. While the two extremes of adoption and abandonment imply a point, or moment in time, that can somehow be gauged, the other responses involve movement across time. It takes time to adapt, configure, and customize. A common way to view this movement over time is through the lens of “alignment.”

<table>
<thead>
<tr>
<th>IS Responses</th>
<th>Description</th>
<th>Representative Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adoption</td>
<td>Unproblematic &quot;acceptance&quot; of new information technology into existing practice.</td>
<td>Davis 1989; Venkatesh et al 2003; Lee et al 2003</td>
</tr>
<tr>
<td>System Configuration</td>
<td>Modify settings and pre-configured options in the new technology to represent existing practice.</td>
<td>Lucas et al 1988; Markus et al 2000</td>
</tr>
<tr>
<td>System Customization</td>
<td>Enhance or alter the program code in unanticipated ways to align with existing practice.</td>
<td>Leonard-Barton 1988; Soh &amp; Sia 2004; Robey et al 2002</td>
</tr>
<tr>
<td>Improvisation</td>
<td>Unforeseen and unexpected methods of appropriation and circumvention (with use) of the new technology.</td>
<td>Orlikowski 1996; Ciborra 2001; McGann &amp; Lyytinen 2005</td>
</tr>
<tr>
<td>Resistance</td>
<td>Avoid using the new information technology, or actively struggle against mandates for its use.</td>
<td>Hirschheim &amp; Newman 1988; Lapointe &amp; Rivard 2005; Keen 1981; Markus 1983</td>
</tr>
<tr>
<td>Abandonment</td>
<td>Persistent failure to use the new information technology.</td>
<td>Lyytinen &amp; Hirschheim 1988; Ewusi-Mensah 1997</td>
</tr>
</tbody>
</table>
7.3. Alignment and Responses to Information System Implementation

A new information technology “almost never fits perfectly into the user environment” immediately (Leonard-Barton 1988, p.252). This lack of fit is often referred to as a “misalignment.” Misalignments are due to wrong technical specifications, different performance criteria, or failed “delivery systems” associated with the new technology (that is, the procedures by which the technology was implemented and the complementary assets associated with the new technology, Leonard-Barton 1988). Leonard-Barton (1988) suggested that organizational processes and the new system mutually adapt to address these misalignments. This process of “mutual adaptation” involves “re-invention of the technology and the simultaneous adaptation of the organization” (Leonard-Barton 1988, p.253). New technology necessarily changes work practices, and that these practices can change in unforeseen ways, thereby necessitating some form of customization. Through “cycles of adaptation,” technology and the user practices will eventually align (see Figure 3).
Since Leonard-Barton's study, many have drawn upon the imagery of mutual adaptation to address misalignments associated with information systems implementation (e.g., Tyre & Orlikowski 1994; Orlikowski 1996; Majczak et al 2000; Susman et al 2003; Soh & Sia 2004; Wei, et al 2005). In a great deal of the literature, however, the notion of alignment goes undefined, or is seen as an unproblematic eventuality, assuming the system continues to be used.

Tyre and Orlikowski (1994) found that mutual adaptation occurred in limited windows of opportunity – usually the first few months - before work practices become “congealed,” as other organizational activities begin to take precedence. In such a case, new windows may be triggered by exogenous disruptions, but these windows become shorter in duration. In other situations, work practice changes can be quite gradual, closely approximating Leonard-Barton's model (Orlikowski
Majchrzak and associates (2000) found that within each cycle of adaptation new misalignments were often uncovered that set off new rounds of mutual adaptation in multiple directions, to result in eventual non-alignment (by the original intention of the implementation). Another study found that organizational actors “will not necessarily experience the same misalignments or interpret them in the same way” (Susman et al 2003, p. 143), as technologies can be misaligned with certain tasks, team structures, or organizational structures that are salient to different groups.

Leonard-Barton (1988) though discussing a number of types of misalignments, does not explicate clearly the idea of alignment. She describes misalignment generally as “mismatches between the technology and the organization,” and indicates that this can be resolved when the technology, delivery system, and performance criteria are aligned. Other work in this tradition offers similar simple treatment of the concept of misalignment, by highlighting the “gaps” or “differences” between technology and the organization (Davenport 1998; Soh et al 2003). Accordingly, alignment takes place when either the technology is appropriated in a way consistent with the organizational practice, or the organizational practice shifts to become consistent with the technology. The concept of alignment, when used in this fashion, makes no distinction between successfully meeting the expectations associated with the system implementation, or not. Under such criteria, failure to use the system at all can conceivably be considered also an alignment with organizational practice.
In a recent treatment of alignment, Lyytinen & Newman (2006) indicate that a socio-technical system in equilibrium strikes a balance between four components: actor, task, technology, and environment. In these equilibrium states, the components of a system are aligned and in disequilibrium states, at least two of the components are not aligned. Such treatment assumes that stability can be reached and maintained for a period of time, which is not an unproblematic assumption, and it also explicitly calls for a balance between the components, which implies that no single component take primacy. In my discussion, this conceptualization is not applicable, as we are specifically interested in whether practice aligns with the system, thus we would require alignment to be in relation to something, not a general state of alignment. Therefore, we want to see if alignment can be gained in relation to certain aspects of the system. In my use of the term alignment, we specifically see whether the studied practice can align with the system. Although this forms a subset of the Lyytinen & Newman equilibrium model, it is the one most often addressed in the literature (Lyytinen & Newman 2006).

However, it is important to be more specific about what, precisely, is loosely coupled or misaligned. Recent research on enterprise systems offers a vocabulary for greater precision in the way researchers can characterize the degree of coupling between practices and enterprise systems (Volkoff et al 2007, see Figure 4).
Business processes are the critical unit of analysis for understanding the impact of enterprise systems; as such systems take a process view of organizations (Davenport et al 2004; Kallinkos 2004). Two important aspects of business processes: the performative and the ostensive aspects⁴ (Feldman & Pentland 2003). The ostensive aspect captures the way individuals view the process, how they think about the process, and how they account for activities in the process. The performative aspect of processes involves the situated carrying out of organizational tasks. “The ostensive aspect of the routine is the idea; the performative aspect, the enactment.” (Feldman & Pentland 2003, p.102) To better understand the relationship between enterprise systems and business processes, Volkoff and associates (2007) adds the material aspect of organizational routines.

⁴ Feldman & Pentland use the term “routine” following Nelson & Winter 1982, however, as Pentland (1995) indicates, the terms “routine” and “business process” can effectively be used interchangeably.
In their view, the material aspect embeds and directly influences the performative aspect, representing the portion of the performative aspect of the routine that is “executed by the technology” (p.840). The material aspect of the process, in the form of an enterprise system's technical implementation, can theoretically bring the ostensive and performative aspects of processes.

From this view of the process, we have three broad dimensions along which processes can be loosely coupled (see figure 3): (1) ostensive-material coupling, (2) material-performative coupling, and (3) performative-ostensive coupling.

1. **Ostensive-material coupling (O-M)** involves the relationship between the technical features of the enterprise system and the way they reflect the goals and principles associated with the system's role in the process. Tight ostensive-material coupling would involve perfect correspondence between the technologies structure and the goals for the technology. In such situations, process maps, for example, would perfectly embody goals and principles associated with the process and maintain a one-to-one correspondence with the technical features in the system. Loose coupling along this dimension, on the other hand, implies that this is imperfect correspondence, and that the technological features do not align with the goals of the system in some way.

2. **Material-performative coupling (M-P)** involves embedding of relevant processes into the enterprise system (Volkoff et al 2007), so that the relevant aspects of these processes are executed in the system. Tight material-
performative coupling would indicate that users appropriate the system as the tool by which they carry out the practices associated with the business process. In the process map example, the technology is in fact used at the points specified in the process map. Loose material-performative coupling, on the other hand, indicates that the performative practices associated with a business process may inappropriately, improvisationally, or partially use the technology.

3. **Performative-ostensive coupling (P-O)** involves the manner in which the enacted practices associated with a given process correspond to the goals and principles associated with the process. In this sense, does the overall process correspond to the process map? Tight performative-ostensive coupling would indicate that the process is consistent not only with the goals and principles associated with the process, but also the explicit sequence of activities and related decision criteria.

In their theory of enterprise system mediated organizational change, Volkoff et al (2005) argue that the material aspects of a process in the form of an enterprise system drive, to some extent, the performative aspect of the process to more closely align with the ostensive aspect. Armed with these three dimensions of coupling between enterprise systems and practice, the framework of dimensions of loose coupling (Table 7), and the key variables of control and integration we look to the five assumptions associated with enterprise system implementation (Table 3) to gain insight into enterprise system implementation from a lens of loose coupling.
7.4. Proposed Framework of Responses to Information Systems

Table 8 below combines the adaptation activities that are prevalent in information systems implementation literature with my application of Oliver's (1991) institutional analysis of responses in Figure 2. Many of Oliver's descriptions are consistent with concepts recognized in the literature, and I have matched these descriptions respectively.

<table>
<thead>
<tr>
<th>New institution embodied by IS</th>
<th>Response strategies - Oliver 1991</th>
<th>Local responses to information system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong pressure; logics congruent</td>
<td>Acquiescence</td>
<td>Acceptance; process adaptation; system configuration</td>
</tr>
<tr>
<td>Strong pressure; logics incongruent</td>
<td>Compromise / avoidance</td>
<td>Process adaptation; system customization; improvisation, resistance</td>
</tr>
<tr>
<td>Weak pressure; logics incongruent</td>
<td>Defiance</td>
<td>Resistance, abandonment</td>
</tr>
<tr>
<td>Weak pressure; logics congruent</td>
<td>Manipulation</td>
<td>--</td>
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</tbody>
</table>

Of these strategies, acquiescence has been addressed at length in information systems literature and we have a wide array of studies of mutual adaptation (Leonard-Barton 1988; Tyre & Orlikowski; Majchrzak et al 2000; Soh & Sia 2004), technology adaptation (Orlikowski 1992; DeSanctis & Poole 1994), and enterprise systems (Davenport 1998; Markus et al 2000; Boudreau & Robey 2005). In contrast, lack of acquiescence, or defiance (and some forms of avoidance), usually framed in terms of “resistance,” also has a rich follow up in the IS literature (Laponte & Rivard 2005; Markus 1983; Keen 1981). Some attention has also been paid to
compromise and avoidance quadrants (Ciborra 2001; Orlikowski 1996; McGann & Lyytinen 2005; Pollock & Cornford 2004; Scott & Wagner 2003; Wagner & Newell 2006). This framework on user responses to generalized information technologies will inform my analysis of enterprise systems. First, however, we will review institutional treatments of information systems to aid in motivating the enterprise system context.

7.5. Information Systems Research and Institutional Theory

Information systems research leverages an institutional perspective in three main ways: (1) descriptions of structuration processes associated with information technology adaptation; (2) diffusion of information technologies across organizational fields such as industries; and (3) recently institutional perspectives have been applied to enterprise systems.

Structurational theorist conceive of information technology as a “trigger” for social structuring (Barley 1986), or as a form of social structure in itself (Orlikowski 1992). In both cases, institutional structures are thought to both enable and constrain the ways that new technologies are used, and these institutional structures are then comprised of the new routines which are now enabled by the technology (Barley 1986; Kling & Iacono 1989; Orlikowski 1992). Although users adopt technology in unforeseen ways, this adoption is constrained by both the material properties of the technology as well as the institutional context, or “institutional conditions of interaction with the technology” (Orlikowski 1992). The material properties of the technology reflect the interpretations and intentions of
the designers, and the institutional structures they draw upon to inform the design of the system, and thus embody rules and resources that reinforce activity in accordance to those institutional structures (Orlikowski 1992). Along these lines, the goals and values implied by the structure of the technology have been described as its “spirit” (DeSanctis & Poole 1994), and implementation of the new technology, as it interacts with an existing institutional context, can change that institutional context (Orlikowski 1992; DeSanctis & Poole 1994; Kling & Iacono 1989). The material properties of the new information technology, which often reflect a specific institutional logic, are seen to both enable and a constraint the institutional structures that result from use (Orlikowski 1992). In this literature, social structures typically remain an abstract concept, explaining idiosyncratic appropriation and offering a framework to think about the way broader institutions may affect and be affected by individual actions.

In the second stream of institutional information systems literature, institutional forces exist at the supraorganizational level, often in the form of government influences on a national economy, and are concerned with the creation or diffusion of information technology innovations across a given field (e.g., King et al 1994; Damsgaard & Lyytinen 2001). Also, in this tradition organizations are treated as the “homogenous, internally isomorphic” actors (Crouch & Farrell 2004, p.32), similar to the way in which organizations are viewed in the broader institutional literature. Organizations as the single actors can vary in their responses to institutional forces (Ang & Cummings 1997).
7.6. Enterprise Systems and Institutions

Enterprise system literature that adopts an institutional perspective also takes this view of organizations. As large, monolithic enterprise systems are introduced in an organization, they may misalign with the “dominant” institutional logic of the organization (Gosain 2004); align with organizational practices (as a whole) after a period of mutual adaptation (Soh & Sia 2004); or “assimilate” within the organization (Liang et al 2007).

My institutional framework on information system implementation extends both of these views of institutions and information systems. Institutional logics are entirely consistent with a structurational view, but can also operationalize certain tenets of this view through an explicit construct (institutional logic) that can be compared for predictive and explanatory purposes. This construct is consistent with specific, known societal-level institutions and organizational-level institutional practices (business processes). Similar to the “supraorganizational force” view of institutions, I appreciate enterprise systems as an institutional force acting upon organizations, who, in turn, have a number of response strategies at their disposal. However, I look at organizations as pluralistic webs of multiple, nested institutions rather than homogenous actors. In this sense, I open the “black box” of the organization to determine responses to institutional forces at the level of practice.
Chapter 8  Enterprise Systems

Enterprise systems are particularly well-suited to institutional analysis (Gosain 2004; Sia & Soh 2007; Soh & Sia 2004) because they are large-scale systems intended to integrate an entire enterprise based on a logic of hierarchical control and integration (Ciborra 2000; Davenport 1998; Gosain 2004).

8.1. Enterprise System Implementations

Markus and associates (2000; Markus & Tanis 2000) suggest four generic phases in the implementation of an enterprise system: pre-implementation “chartering”; the during implementation “project”; post implementation “shake-out” (sometimes called “shakedown”); and the later “onward and upward” phases. In the pre-implementation phase of the enterprise system project, anticipated misalignments are typically corrected through user training and configuration of the system. This generally involves setting the parameters within the system to meet the specific requirements of the organization (i.e., “system configuration,” Markus et al 2000; Gosain 2004; Wei et al 2005).

During enterprise system implementation, and immediately during the post-implementation, “shakeout,” phase (Markus et al 2000; Wei et al 2005; Gosain 2004), further misalignments are uncovered. At this stage, misalignments can be resolved through two mechanisms: (1) customization of the enterprise system; (2) adaptation of work practices to the enterprise system (Lucas et al 1988; Robey et al 2002; Hong & Kim 2002; Soh & Sia 2004). Customization differs from configuration
of the system, as configuration implies working within the confines of the standard functionality within the system, whereas customization involves some change to the functionality of the system (Markus & Tanis 2000). Of course, within this customization and adaptation space there remains a wide opportunity for user “work-arounds” or improvisations in many forms (Orlikowski 1996; Soh et al 2000; Ciborra 2001; Pollock & Cornford 2004; Soh & Sia 2004; Boudreau & Robey 2005; Wagner & Newell 2006). Thus we see that views of enterprise system implementation mirror the wider literature on information systems in general, with three primary caveats.

The first caveat is that an enterprise system implementation is never really complete – there are always new modules and new organizational units to bring on board as the system implementation continually moves “onward and upward” (Markus & Tanis 2000). Secondly, organizational acceptance of the system is rarely voluntary – as such systems cost well into the millions or hundreds of millions of dollars (Robey et al 2002), outright abandonment of the systems is never really an option in the near term. Even though the majority of enterprise system implementations may be considered “failures” according to certain criteria (Liang et al 2007), they inevitably continue to be used by an organization in some form after implementation. Finally, and perhaps most important to my institutional perspective, is that one might argue that “point” solution information technologies are more often consistent with practices within a given functional domain, because they were designed with that domain in mind. Enterprise systems, on the other hand, cover a variety of organizational domains and such systems can be expected
to be incompatible with certain domains – after all, salesmen view their practices quite differently than accountants do.

8.2. Definition of “Enterprise System”
Enterprise systems are “commercial software packages that enable the integration of transactions oriented data and business processes throughout an organization” (Markus et al 2000, p.245). While such systems typically grew out of manufacturing systems known as “materials resource planning” or “MRP” systems that expanded to handle the data of an enterprise (hence “enterprise resource planning” or “ERP”). Such systems involve independent functional modules that embody typical industry (“best”) practices and are integrated with each other through a common database (Wagner et al 2006). Organizations implement these systems in a modular, incremental fashion or through “big bang” approaches where they attempt to implement many modules at once (Robey et al 2002; Markus and Tanis 2000). In his seminal article on the topic, Davenport (1998) describes the value of these systems to organizations:

*These commercial software packages promise the seamless integration of all the information flowing through a company - financial and accounting information, human resource information, supply chain information, customer information. For managers who have struggled, at great expense and with great frustration, with incompatible information systems and inconsistent operating practices, the promise of an off-the-shelf solution to the problem of business integration is enticing. (Davenport 1998, p.21).*

Although the promise of these systems is quite appealing it is important to appreciate how the techno-rationalistic focus on efficiency an integration may be particularly appealing to certain domains within a given organization (think
manufacturing and accounting) but can conceivably be quite inconsistent with other (think sales or R&D).

8.3. Goals & Logic Associated with Enterprise Systems

Large-scale, standardized enterprise information systems are implemented across a wide array of activities in and across organizations. The goals associated with enterprise system implementations generally involve the integration of the data driving these practices, and the resulting tighter hierarchical control of these activities (Davenport 1998; Dechow & Mouritsen 2005; Volkoff et al 2005).

<table>
<thead>
<tr>
<th>Table 9. Assumptions Associated with Enterprise System Implementation</th>
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<tbody>
<tr>
<td><strong>1. Integration &amp; Control</strong></td>
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<tr>
<td>1a</td>
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<td>1b</td>
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<tr>
<td><strong>2. Misalignments</strong></td>
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<tr>
<td>2a</td>
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<tr>
<td>2b</td>
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<td>2c</td>
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Themes of loose coupling across both domains of integration and control are evident in the literature, and loosely coupled phenomena are typically characterized
as “misalignments” between the system and organizational practices (Soh et al 2000; Sia & Soh 2007). There are a number of assumptions that are prevalent, often implicitly, in the literature concerning the notions of integration, control, and misalignments in enterprise systems contexts. Researchers frequently use and re-established these assumptions without evidence of critical appraisal and careful scrutiny. Next we will briefly introduce these assumptions (see Table 9) then address each one more fully.

As enterprise-wide standardized infrastructures, enterprise systems are intended to integrate certain processes across organizational units and functions through the common data associated with a unified set of applications that utilize a common database (Davenport 1998; Markus & Tanis 2000). While integration in itself is often treated as a key goal associated with an enterprise system (e.g., Barki & Pinnsoneault 2005; Volkoff et al 2005; Gattiker & Goodhue 2005), integration also drives other benefits such as efficiency across organizational practices (Shang & Seddon 2002), improved knowledge sharing (Srivardhana & Pawlowski 2007) and increased managerial control over organizational activities (Davenport 1998; Volkoff et al 2005). Since standardization is the key enabler of integration (Light & Wagner 2006) enterprise systems are often characterized as instruments of centralized, rational management control over the relevant practices (Ciborra 2000; Elmes et al 2005; Kallinikos 2004; Gosain 2004). Paradoxically, while enterprise systems enable flatter, more “democratic” process-oriented organizational structures, they do so through an increase in centralized control Enterprise systems allow hierarchical control of processes by both enforcing managerial standards into
the system (Davenport 1998), and by providing the visibility of real-time data for managers to both monitor these processes, and to make informed decisions (Elmes et al 2005).

From this review of the literature, we find three broad types of integration, and two forms of control. First, Barki & Pinnsonneault (2005) define integration as “the extent to which distinct and interdependent organizational components constitute a unified whole” (p.166), which implies that these integrated components maximize their responsiveness to each other, are highly interdependent, and are, essentially, tightly coupled. Three broad forms of data integration are evident in enterprise system contexts:

- **Structural integration, in an enterprise system context involves the tight coupling of organizational units (i.e., functional groups, business units, organizations) together.** This integration is enabled by tightly coupling the processes that cross both units.

- **Process integration in an enterprise system context involves the tight coupling of organizational activities (i.e., tasks, processes) together.** This tight coupling is enabled by the use of common data.

- **Data integration in an enterprise system context involves the tight coupling of organizational data to the central database.** (Which, at a minimum requires common data definitions across organizational groups, see Goodhue et al, 1992.)

A commonly-used definition describes “control” as the “purposive influence toward a predetermined goal” (Beniger 1986, p.7). Using this definition, we see that centralized control is evident in at least two ways – guiding organizational activity
through procedures that are enforced by the system (Kallinikos 2004), and visibility that allows monitoring of individual activity. Elmes et al (2005) refer to these as bureaucratic and disciplinary control:

- **Bureaucratic control in an enterprise system context involves control of relevant organizational activity in line with the practices implied by the system.** This proactive form of control requires adherence to prescriptions associated with the systems, and is required for data integration.

- **Disciplinary control involves the monitoring organizational activity to enforce proper organizational practices.** This reactive form of control requires the data in the system to faithfully reflect the data used in organizational practices.

Through this discussion of both integration and control, we see a hierarchical relationship between the different forms of integration, and a recursive relationship between integration and control. Thus the twin objectives of integration and control appear to not only be consistent with each other, but also to be mutually reinforcing. However, the integration and the related control associated with enterprise systems have proven to be elusive in practice (Ciborra 2000; Dechow & Mourtisen 2005).

### 8.4. Related Perspectives on Enterprise Systems

The notion of an institutional logic has been applied directly to an enterprise system implementation – in cases where structures implied by the system may not align with the “dominant” institutional logic of the organization (Gosain 2004, p.167). In this I only differ in that I look to address this congruence on a practice level – with
the plurality of institutional logics within an organization. Similarly, Soh and Sia (2004; Sia & Soh 2007) contrast the misalignments between the social structures “embedded” in the enterprise system, and the social structures incumbent in the organization.

Davenport (1998) also used the term “logic” to describe inconsistency between the organization and the enterprise system, but his use of the term was from a strategic lens, rather than an institutional perspective (although the two can be married quite effectively – e.g. Oliver 1991). Consistent with this strategic view of enterprise systems, many commentators highlight the tensions between the global, standardized nature of a packaged enterprise system with the diverse local contexts (Fleck 1994; Rolland & Monteiro 2002; Soh et al 2003; Ciborra 2000; etc.).

Other enterprise system researchers have used a variety of terms to describe the underlying structures associated with such systems and the contexts in which they are implemented, including “value conflicts” (Allen 2005); competing actor-networks (Pollock & Cornford 2004); the procedural focus implied by the enterprise system with other “modes of human involvement” (Kallinikos 2004); and tensions between the ERP system and “epistemic cultures” (Wagner & Newell 2004). Again, it is not the goal here to compare and contrast each of these, but rather, to indicate that the congruence of institutional logics is a consistent lens that is quite compatible with a variety of enterprise system-related theorizing.

In this review of the literature, I have attempted to root my research in a novel institutional perspective that combines institutional pluralism with the construct of
an institutional logic, thoroughly review the concept of loose coupling, develop a framework for local responses to an enterprise system, and position a specific view of enterprise systems within the literature. Next I will present a summary, limitations, and contributions of my research findings.
Chapter 9  Research Highlights

The research supporting my arguments took the form of three discrete studies. The fundamental thread that runs through the three projects involves the exploration of the relationship among three different concepts: (1) institutional logics, (2) loose coupling, and (3) enterprise systems implementation. It is my assertion that by identifying the specific institutional logics that guide incumbent organizational practices, it is possible to discern whether these logics are congruent with that of a newly introduced information system, and thus predict or explain situations where practice remains loosely coupled with a newly introduced system. The first study involves identifying the conditions under which loose coupling occurs; the second depicts the way in which loose coupling occurs and is maintained in a highly institutionalized organization, and the third study addresses the temporal nature of this loose coupling. Following I will address the research questions and key findings of each study in turn, followed by a synthesis.

9.1. Study 1: Conditions for Loose Coupling

The first study involves identifying the conditions under which loose coupling occurs. Using Orton & Weick's (1990) framework, this study address the first relationship “causes of loose coupling” (see Figure 5).
The primary research question for this study was: *What are the drivers of this loose coupling in an enterprise system context?* To address these questions, I leverage the institutional framework (described in section 7.4) to develop four conjectures which I will now describe.

**Conjecture 1:** Given strong institutional pressures to conform, individuals whose local practices are guided by institutional logics congruent with that of an enterprise system will respond to the implementation of the enterprise system through mutual adaptation leading to eventual alignment.

Our first conjecture about response strategies that involve “acquiescence” or mutual adaptation with the system was consistent with much of the literature that treats compliance primarily as a technical issue that can be resolved by either customizing or configuring the system, or by changing practices to align better with the system (Soh et al 2000; Markus et al 2000; Wei et al 2005). While our analysis supports this conjecture, it is important to note Ciborra’s and Failla’s (2000) description of the extreme amount of effort spent on training and advocating the enterprise system – although
congruent, it still took years to take root. In their example, even after taking four years to take root (largely with the help of a complementary application), the level of system adaptation remained inconsistent throughout the organization. With today’s fast-changing industry conditions, waiting more than four years for an enterprise system to become “ready-to-hand” (Ciborra 2000) across the organization is simply too long. The case suggests that a similar story may be the reality in many implementations.

Conjecture 2: Given strong institutional pressures to conform, individuals whose local practices are guided by institutional logics incongruent with that of an enterprise system will respond to the implementation of the enterprise system by loosely coupling their practices with the system through compromise or avoidance.

In our second conjecture, we expected “partial compliance” strategies that lead to the loose coupling of practice with the enterprise system. This second conjecture is an important departure from treatments of “misalignments” of organizational practices with the enterprise system (e.g., Soh & Sia 2004). First, by focusing on institutional logics that guide practices rather than the practices themselves, we are able to distinguish between surmountable, technical barriers to implementation that might be resolved by adaptation, and those that will not. Adaptation responses involve more training, upper management support (greater force), technology tweaking, or process change, and result in progress toward eventual alignment of the practice with the system. If the practices are fundamentally incongruent – which, we argue, would be identified through an analysis of the institutional logics that
guide that practice – then this alignment will not occur without changing the practice to something entirely different. Our conjecture appears to be supported by the case data. This result implies that partial compliance allows for existing practices remain unchanged, whereas full compliance can only be reached by changing the nature of these practices.

In one case, however, the response to incongruent institutional logics appeared to involve sincere compliance (Volkoff et al 2005). There are at least two plausible explanations for these findings. One is that our model is wrong, and that we are missing an important confounding variable, or response type. Another explanation is that the researcher took the compliance with the system at a face value, while there might have been, in fact, “minimal” use of the system which would be consistent with our partial compliance strategy. Perhaps the quality and efficiency problems resulting from the system implementation hint to this explanation, as efficiency and data integration are fundamental objectives of the system. Yet, the outcomes do not appear to be consistent with these objectives.

**Conjecture 3:** Given weak institutional pressures to conform, individuals whose local practices are guided by institutional logics incongruent with that of an enterprise system will respond to the implementation of the enterprise system with resistance.

**Conjecture 4:** Given weak institutional pressures to conform, individuals whose local practices are guided by institutional logics congruent with that of an enterprise system will respond to the implementation of the enterprise system with an attempt to manipulate / control the implementation.

Our third and fourth conjectures address situations where the enterprise system was introduced without a great deal of pressure, and this form of
Introduction was invariably met with resistance. This resistance was manifested in a form of overt conflict (e.g., Wagner & Newell 2004) or simply ignoring or avoiding system use (e.g., Boudreau & Robey 2005). An important observation is that resistance seems to be temporary and often leads to something else – eventual acceptance, loose coupling, co-opting, etc. Strategies for dealing with resistance tend to involve gradually increasing the strength of the institutional pressure (Boudreau & Robey 2005; Dahlbom et al 2000). Once the strength is increased, congruent practices approach alignment through mutual adaptation, whereas incongruent practices respond with partial compliance that loosely couples those activities from the system. Of course, the other option is for the group to co-opt the system introduction. Although this strategy is evident in the Lee & Myers (2004) case, it is clear that this possibility is not adequately addressed in the literature.

9.2. Study 2: Description of Loose Coupling

The second study represented a grounded analysis of post-implementation field data relating to NASA's enterprise system implementation. This study consisted of three rounds of coding 68 interview transcriptions in a grounded effort (Appendix B). The domain addressed by this project is depicted in Figure 6, and the research questions motivating the study are addressed in turn.
Are there any institutional regularities that help us to explain situations of loose coupling?

In addition to eliciting generalizable forms of loose coupling, we identified a number of institutional logics at play in NASA, and we looked to understand how they relate to the enterprise system implementation. In the literature, enterprise systems have been characterized to embody a highly rationalized institutional logic (Gosain 2004), which is associated with values of efficiency and control (Ciborra 2000). Our analysis of NASA’s enterprise system is consistent with this characterization – but it is important to note that the enterprise system implementation does not spring up from purely internally motivated technical concerns. It occurs in conjunction with presidential initiatives that encourage governmental agencies to act more like businesses. Also, it occurred in the wake of audits from government agencies that require better accountability and control from NASA. Together, these initiatives
indicate that NASA is under institutional pressures in line with the well-established institution that can be called “managerial rationalism.” According to Townley (2002), managerial rationalism, when applied to government agencies, involves business planning and a focus on performance through “myths of efficiency, value for money, improved management competence and increased management accountability, and greater control over public expenditure and, through this, an enhanced legitimacy for government” (p. 169). The institution we refer to as managerial rationalism appears under different names throughout a variety of institutional analyses, such as “bureaucratic rationality” (Meyer & Rowan 1977) and “managerialism” (Kitchener 2002). Managerial rationalism stands in contrast to practice-based institutions that involve the crafts or professions – what Meyer and Rowan (1977) describe as “categorical rules” apply to professions, which informally, normatively guide action that cannot be readily rationalized. Institutional logics associated with professions are widely characterized to conflict with the logic of managerial rationalism (e.g., Townley 1997; Kitchener 2002).

Table 10: Selected NASA Institutional Logics, Related Institutions, and Practices

<table>
<thead>
<tr>
<th>Locus</th>
<th>Logic</th>
<th>Related Institution</th>
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<tbody>
<tr>
<td>Enterprise System</td>
<td>Logic of Managerial Rationalism</td>
<td>Managerial Rationalism</td>
</tr>
<tr>
<td>Project Managers</td>
<td>Logic of Project Management Professionalism</td>
<td>Project Management Profession</td>
</tr>
<tr>
<td>Researchers</td>
<td>Logic of the Scientific Professionalism</td>
<td>Science &amp; Engineering Profession</td>
</tr>
<tr>
<td>Center Administrators &amp;</td>
<td>Logic of Organizational Persistence</td>
<td>NASA organizational unit (Center, performing organization, or office)</td>
</tr>
<tr>
<td>Research Management</td>
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In the case of NASA, while some individuals draw on the institutional logic of managerial rationalism, many others draw on alternative, often conflicting institutional logic in response to the ERP implementation (see Table 10). For example, project managers and researchers indicated that the goals, assumptions and identities that drive their actions were not always consistent with the enterprise system. Many project managers identified with tracking variance of unpredictable projects, while many researchers were concerned with advancing the state of knowledge in their respective professional scientific fields. Neither of these logics was consistent with the linear, evenly parsed, and predictable imperatives of the enterprise system.

Beyond the professions, organizations themselves can evolve into institutional status in certain circumstances (Scott 2008). Certainly NASA as an agency is an institution within the wider institution of the U.S. Government. The centers have also attained institutional status as they are deeply implicated in local communities, the lives of their stakeholders, and in local politics. As such, the survival of centers becomes an end in itself and this is evident in the espoused logic of the center managers who are looking to find ways to maintain the competencies of the center in the face of pressure to rationalize the center. On a smaller level, research groups within NASA reflect same drive for persistence.

Thus, our data supports our central thesis that: in situations where the institutional logics that guide action are in conflict with the institutional logic of the enterprise system, that practice appears to be loosely coupled from the data in the system that is intended to represent that activity. This analysis highlights how contemporary
organizations are a nexus of heterogeneous institutional logics. It further shows how micro-level activity reflects the interplay of these broad societal-level institutions and how individuals reflexively deal with often conflicting institutional logics as they struggle to maintain a coherent identity (Friedland & Alford 1991; Thornton & Ocasio 2008). Each of the institutions we addressed represents ideologies, professions, and institutionalized organizations, and the activities we describe illustrate how practices relating to an enterprise system implementation are deeply embedded in this nexus of institutions. Through this institutional lens, we take a step toward identifying regularities and consistencies associated with situated, apparently idiosyncratic behaviors (Scott 1990).

**How is loose coupling maintained in the face of institutional pressure to adopt the prescriptions of an enterprise system?**

Given the existence of multiple and diverse institutional logics that influence individuals actors at NASA in a variety of ways, how do individual actors in NASA reconcile different institutional logics and maintain a sense of coherence in their work practices? Our literature review suggests that loose coupling is a prevailing mechanism for such reconciliation. Our findings not only confirm the existence of such loose coupling, but further suggest four generalized forms of loose coupling.

First, as seen in the previous section, many project managers loosely couple their tracking and reporting activity by periodically extracting data from the system and using this data within their own local applications. Similarly, in the example of bank card purchases, researchers avoid the purchasing process entirely and only later reconcile it with researcher budgets. Although in both of these cases the data in both systems may be the same at the point of extraction or reconciliation, this data is not continuously updated and made visible – there is a lag in responsiveness of certain
organizational elements and the system. Here, temporal loose coupling between the ERP and local practices are used to reconcile the conflicting institutional logics.

<table>
<thead>
<tr>
<th>Form of Loose Coupling</th>
<th>Description</th>
<th>Level of Analysis</th>
<th>Relevant ERP Benefit Compromised</th>
<th>NASA Example &amp; Enabling Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal</td>
<td>Time lag</td>
<td>Process</td>
<td>Real-time data</td>
<td>Project tracking: Systems used for project management periodically reconciled with enterprise system</td>
</tr>
<tr>
<td>Material</td>
<td>Physical redundancy</td>
<td>Technical</td>
<td>System / application integration</td>
<td>Budgeting: Shadow systems (spreadsheets) to track actual budgets</td>
</tr>
<tr>
<td>Structural</td>
<td>Mediated interaction</td>
<td>Organizational</td>
<td>Universal system use</td>
<td>Researcher procurement: Mediated researcher system use; circumvention through bank cards</td>
</tr>
<tr>
<td>Interpretive</td>
<td>Sensemaking</td>
<td>Personal</td>
<td>Control &amp; visibility</td>
<td>Time reporting: Individual sensemaking; creative interpretation in time reporting</td>
</tr>
</tbody>
</table>

Also, there are cases where individual actors resort to a third system to mediate ERP use. Here, NASA does not enjoy the single point of data capture and reduced manual coordination activity associated with tight coupling of organizational activities, or “process integration” expected from the implementation of an enterprise system. Here, we see material loose coupling where technological artifacts are used to resolve the conflicts between institutional logics of ERP and local practices.

In another example, we found that researchers do not typically use the system for their purchases, but instead appoint a single individual through which to mediate their system usage. In many cases, this appointed person often is a “super user” who received early training in the same local group. However, in other cases, we saw an emergence of new category of positions as a result of ERP implementation. For
example, Glenn Research Center temporarily recruited two of its purchasing specialists to train researchers and engineers how to properly purchase through the system. Even though their official role as a trainer was over, they found themselves continuing to deal with a stream of questions and requests from engineers and scientists for various types of purchasing requests that were rejected by the system. Often they ended up fixing the problems themselves, after learning what researchers and scientists were looking to do. Many scientists and engineers soon learned the “trick” to fool the system to accept an incomplete order, knowing that these two purchasing specialists will call them to complete the purchasing order through the system. The purchasing department eventually made their new positions permanent - system usage is now mediated rather than universal. Here, we see structural loose coupling where new roles are established in order to resolve tensions between the institutional logic of ERP and that of local practices.

Finally, center administrators process budgetary data outside of the system to make reported budgets fit with projections, and research managers creatively interpret time reporting mandates to encourage researchers to bill more of their time to funded projects. In both of these cases, for any given period, data reported in the system may, in fact, vary widely from the activity it is intended to represent. Thus the control enabled by tight coupling of organizational activity to an enterprise system (Ciborra 2000; El Amrani et al 2006) is ostensibly weakened by interpretive loose coupling.

Table 8 summarizes the four forms of loose coupling we identified in our analysis of NASA’s ERP implementation. These four forms are not mutually exclusive, as for example the temporal and material forms are both evident in the project tracking
process. However, they enable us to be more precise in articulating the ways in which loose coupling can be maintained when an enterprise information system is introduced into an institutionally plural organizational environment.

**Is this loose coupling uniform within organizational groups?**

It is important to note that in our analysis of NASA, the espoused institutional logics are not uniform across entire organizations, or even groups within those organizations. As individuals draw upon specific institutional logics to guide specific actions, there may be inconsistencies between such practices, resulting in their loose coupling. We found that within three different groups – where there appeared to be a “dominant” institutional logic – there was inevitably a significant number of individuals espousing an alternative logic. In these situations their activity appeared to be more tightly coupled with the data in the enterprise system. For example, the center managers that espoused a managerial rationality did not report any shadow systems; the project manager that espoused the managerial rationality encouraged faithful project tracking; and the researcher who indicated that administrative activity was part of his job used the system directly for purchases. In the case of time reporting, researchers were required to attribute their time to projects. While this was not a problem for some, those who indicated that Full Cost initiative was appropriate for NASA experienced some dissonance (Bacharach et al 1996) at their loose coupling, as evidenced by negative attitudes (“we feel like we’re lying”).

Contemporary organizations do not maintain this integration and organizational coherence because individual actors in organizations share the same identity. To the contrary, our study suggests that organizations maintain its coherence through
constant reconciliation between heterogeneous and often conflicting institutional logics that influence different pockets of actors in the organization. The integration among dispersed, idiosyncratic local practices, then, is an inherent dynamic process that always remains problematic. In that process, organizational actors do not lose their own unique sense of identity that defines who they are and their work. Instead, they can continue to deepen their own identity and constantly make sense of their purpose through mechanisms of loose coupling (Weick 2001). Such a pluralistic perspective is radical departure from the bulk of institutional research that treats organizations as singular actors that identify with a single, or dominant, institutional logic (Gosain 2004; Currie & Guah 2007). Our work also extends the view that describes how local, situated groups and individuals idiosyncratically respond to enterprise system implementations (e.g. Ciborra 2000), as our analysis ties this idiosyncratic appropriation of technology to society's broader institutions. Thus such idiosyncratic appropriations of technology can be understood through the multilevel connection of micro-level practices to society's broader institutions.

Thus, the pluralistic institutional lens offers an alternative theoretical lens for stratifying organizational actors, beyond functional groups (e.g., Lawrence & Lorsch 1967) or communities of practice (Wenger 1999). Our analysis indicates that the assumption of group uniformity – either through functional groups or communities - may not be sufficient for “pluralistic” organizations (Kraatz & Block 2008) awash in multiple, often conflicting, institutional logics, and this is particularly relevant in an enterprise system implementation. The lens of institutional logics allows for differentiation within groups of responses to new enterprise systems, and also allows for differentiation within individuals in their responses to the system's role.
in different practices, as different practices of the same individual may be guided by different institutional logics, as well as the same practice over time.

We highlight how a focus on the level of practice – rather than that of organizational groups or entire organizations – may be the appropriate level of analysis for understanding user responses to enterprise system implementations, given the power of individual human agency (Boudreau & Robey 2005) and the all-encompassing nature of enterprise systems. By identifying a set of institutional logics that an individual draws upon to guide specific practice, researchers may be able to better understand individual responses to enterprise systems. In our analysis, we found that inconsistent institutional logics did result in misalignments, consistent with Gosain (2004) and Sia & Soh (2007), but these institutional theorists indicated that in order for this misalignment to be resolved, either the enterprise system must be customized, or the organizational practices must be adapted to the system. To the contrary, we found four instances of loose coupling where this tightly coupled alignment is not evident.

9.3. Study 3: Loose Coupling over Time

The third study involves grounded research into the four years after NASA’s ERP implementation which included interviewing 30 of the same informants four years later, along with 10 new informants for a total of 110 interviews (some multiples in each phase), in addition to a relevant document analysis (see Appendix C for more detail). As Figure 7 indicates, this study involved a finer-grained understanding of types of loose coupling and their dynamics over time, their direct effects, and their
effects on organizational outcomes. Following we will briefly present findings associated with each research question.

What are the forms of loose coupling in business processes evident in NASA’s enterprise system implementation, based on the ostentive-material-performative framework (Volkoff et al 2007)?

What are the direct effects of these different forms of loose coupling – particularly on the key variables of integration and control?

Based on observation associated with each column in the data, we found that (1) different forms of loose coupling have different effects; (2) attempts to reconcile different forms of loose coupling have different effects; (3) loose coupling tends to promote knowledge worker satisfaction and process stability; (4) depending on the form of loose coupling, process integration and process control may be positively, negatively, or orthogonally related.
Table 12: Forms of loose coupling in business processes: examples & outcomes

<table>
<thead>
<tr>
<th>Forms of loose coupling</th>
<th>Description</th>
<th>Example</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-P</td>
<td>Material-Performative: Relevant aspects of the process partially executed within the system.</td>
<td>Mediated researcher procurement as the system was not used by researchers, but was still the primary system for researcher purchases.</td>
<td>Frees up researcher time, but less integration: additional administrative person – no single point of data entry</td>
</tr>
<tr>
<td>P-O</td>
<td>Performative-Ostensive: Enacted practices correspond to the goals and principles associated with the process.</td>
<td>Researchers circumvented purchasing through P-Card process.</td>
<td>Easier, faster process; but less control; data sometimes misrepresented</td>
</tr>
<tr>
<td>M-O</td>
<td>Material-Ostensive: Technical features of the system incompletely reflect the goals and principles associated with the system’s role in the process.</td>
<td>Service checkers mediated orders to check accuracy, compliance, and routing of orders due to limitations of the system functionality.</td>
<td>Increased control, better order throughput, but additional administrative person</td>
</tr>
<tr>
<td>O-O</td>
<td>Ostensive-Ostensive: Goals and principles associated with the process not entirely consistent.</td>
<td>Creation of Business Warehouse reporting tool for project managers to access data.</td>
<td>Data in appropriate format for project managers, but decreased integration: not real-time; delayed control only</td>
</tr>
<tr>
<td>P-P</td>
<td>Performative-Performative: Aspects of enacted practices that partially correspond.</td>
<td>Researchers report time in according to what is allowed, rather than what is actually spent on each project.</td>
<td>Allowed for load balancing; meeting budgets; data not necessarily accurate</td>
</tr>
<tr>
<td>M-M</td>
<td>Material-Material: Technical functionality not fully integrated.</td>
<td>Purchase requisition information in header rather than appropriate fields.</td>
<td>Simplicity / easy approval; but non-integrated data structure.</td>
</tr>
</tbody>
</table>

What are the dynamics of this loose coupling over time? That is, how do these dynamics relate toward the image of mutual adaptation toward eventual alignment?

What is immediately apparent in the data is that none of the incidents of loose coupling (or decoupling in the case of project management reports) were resolved to eventual integration consistent with the initial ostensive
aspects of the processes. In every case, NASA settled for less than perfect integration along some dimension or another. For example, in the case of the header information, data integration was imperfect; in the case of mediated system usage, process integration was imperfect; and in the case of researcher time reporting, structural integration was imperfect. In the strict sense of full integration that was originally planned – the promise of “a single point of data entry which will eliminate reconciliation” (see NASA goals p.30) simply did not result. Although we did not find the result of alignment in the form of perfect integration, we did see the process of mutual adaptation, but what we found was that when loose coupling was evident upon implementation, after periods that can be characterized as mutual adaptation, the relevant business process appears to settle into what we describe as a “semi-stable state of loosely coupled equilibrium.”

What are the organizational effects of loose coupling, specifically in terms of enterprise system success?

Knowing full-well that it can be framed otherwise from certain perspectives, we present evidence that the NASA ERP implementation can be deemed a success as many objectives were met:

1. **Accountability and Legitimacy** – As a part of the U.S. Government, NASA is beholden to other branches of government and must establish itself as a responsible, reliable agency (or at least the convincing appearance of such). This has been a problem throughout the history of NASA, as many activities are so unpredictable and budgets are politically motivated that
little can be predicted (Center Manager B; Researcher G). In the example of the International Space Station, audits from the GAO (2002-2005) repeatedly indicated that NASA simply cannot report how much money the Agency spent on the project. The GAO then offered five prescriptions for NASA to improve accountability through Integrated Financial Management. In the only audit report since 2005, the GAO (2007) reported that NASA had, in fact, addressed the GAO concerns with Integrated Financial Management; and an audit of the International Space Station (GAO 2008) used budgetary numbers from NASA, with apparent faith in these numbers. We could find no evidence that NASA continues to have problems reporting the costs associated with the Space Station effort.

2. **Financial Integration between Centers** – Before the enterprise system, each Center had its own system and project managers avoided moving funds between centers because it took weeks and would sometimes get lost (based on data from Project Manager G, among others). Now project teams can transfer funds without losing them in a few intermediated clicks (Project Manager C in T4 of Findings2). Without this financial integration, the collaboration required to realize One NASA and Ten Healthy Centers would not have been possible.

3. **Control Transition** – A key goal of both the former Full Cost, and the current Programmatic Budgeting, was to put the control of funding, and
thus the activity of the Agency, in the hands of the Strategic Enterprises. Although this control is imperfect (evidenced by surfing WBS numbers, load balancing, and creative time charging), the organization has made a number of tough decisions to drop certain capabilities and transition personnel to the work funded by projects and programs. Funding decisions are now in the hands of the programs and projects (Project Managers E&G), and center management has lost much of the discretion they once had (Research Managers D&B; Center Manager A; Researcher H). Without the enterprise system this simply would not have been possible.

4. **Time Tracking** - The time and attendance portion of the enterprise system (WEBTADS) is used Agency-wide, and has been hailed as the best such implementation of a time and reporting system in the U.S. Government.⁵

5. **Purchase Requisitioning** – Although doubly mediated, if all goes well, new purchase requisitions make it to the appropriate procurement staff or buyers within a day. In the past this took more than a week (Service Checker B).

6. **Project Reporting** – Project Managers and related staff indicated that their intermediated use of Business Warehouse, reporting from the

system is now adequate for their needs (Project Managers C, F, G, D, E and Administrative Project Support C).

7. **Technical Success** – The system is implemented and stable, performs adequately, received a presidential “green light” assessment, and is supported by a dedicated competency center (Implementation Manager B&C). Further, upgrade goals have been met on time, and the Agency is making progress on governance processes and compliance with oversight recommendations (GAO 2007).

As loose coupling involves less integration and less control, and system success results in more integration and more control, we are essentially making the argument that less integration and control results in more integration and control. To resolve this apparent dilemma, we propose a multi-level model (Burton-Jones & Gallivan 2007) for system success that highlights the role of loose coupling and stability (see Figure 8).
In the “critical success factors” literature for ERP implementation (Holland & Light 1999; Hong & Kim 2002; Al-Mashari et al 2003; Akkermans & van Helden 2002), a variety of common factors have been identified that increase the likelihood of a successful enterprise system implementation. Only through a successful implementation can ERP-related outcomes be realized. Of course, in an enterprise context there is no definitive “success” moment (Markus et al 2000) and successful outcomes must continually be reestablished. Thus, we argue that the stability of the system over time mediates the relationship between implementation-oriented success factors and the implementation success and resulting outcomes.
Perhaps one of the most counter-intuitive findings of our analysis relates the stability enabled by a great deal of loose coupling combined with our assertion that this implementation was quite successful. A logical implication one might draw is that an enterprise information system can actually be a mechanism for maintaining NASA’s loosely coupled organizational structures.

Funding sources in both the Executive and Legislative branches of the U.S. Government – through OMB and GAO audits – put a great deal of pressure on NASA to show integration, control, accountability, and standardization through an integrated financial management system. As this system is up and running, stable, and balances its overall budgets on a high level, the fact that there is non-integration, some lack of control, etc. in the ranks and at the fringes of the system is really not material to these organizations, as long as it all balances out in the end. These other branches of the U.S. Government cannot control NASA’s activity at any deep level of granularity, nor can they control outcomes to any great extent, due to the nonlinear, unpredictable, radically innovative nature of the work. Thus maintenance of legitimacy is a key concern for NASA, and a primary reason for implementing the enterprise system. Through loose coupling in key areas – such as the reporting and tracking of researcher activity, load balancing of budgets at either the center or project levels, and to a lesser extent, through mediating the system use valuable knowledge workers.
An interesting point is that, while the enterprise system was, to a large extent, implemented for purposes that involved legitimacy, and even in the context of a good deal of loose coupling, key inter-Agency financial integration did occur, and the control over budgets did transfer largely form the Center managers to the project managers. On a large scale, the objectives associated with integration and control did occur, even if they occurred imperfectly on a local level. Thus the outcomes of then enterprise system are threefold: (1) the enterprise system enables a façade of neat, orderly fixed budgets and linear progress; (2) the enterprise system allows for integration and control at a high level; and (3) the integration and control associated with the system is imperfect and not all-encompassing, providing a (necessary) space for local indeterminacy, nonlinearity, and surprise. As Figure 15 indicates, the locus of loose coupling may have moved – whereas in the past the center managers were key insulators of research activity, much the way the “technical core” is insulated by management from environmental turbulence in classic management literature (Thompson 1967). As the notion of loose coupling indicates the presence of both tight coupling and partial or non-coupling, this analysis of NASA’s enterprise system implementation finds that the enterprise system itself, complete with all of the trappings of a tightly coupled, mechanistic organization, is actually a mechanism for loose coupling.
9.4. Synthesis – Toward a Theory

Based on Orton & Weick's (1990) framework, Figure Y presents the synthesis of our findings toward a theory of loosely coupled business processes in a context of an enterprise system implementation. Next, I will briefly address each implied relationship.

Institutional conflicts drive loosely coupled responses to enterprise systems. Specifically, when the enterprise system is introduced with a great deal of pressure (this could be coercive, normative, or mimetic force, DiMaggio & Powell 1983; Liang et al 2007), and the institutional logics that guide local practices conflict with the institutional logic of the system, those practices will loosely couple from the system, or they will cease to be the same practice.
Also, the resulting loose coupling can take a variety of forms. This loose coupling could involve performative aspects of practice that are not reflected in the ostensive aspects (P-O), or the material functionality of the system does not embed the situated practices (M-P), or does not align with the ostensive aspects of the business process (M-O). In addition, this loose coupling could involve a compromise of the goals of the system implementation (O-O); for one portion of the performative practice to be only partially linked with another part of performative practice (P-P);
and for the functionality of the enterprise system to be incompletely integrated with itself (M-M).

Each of these forms of loose coupling can be enabled by a variety of mechanisms such human or system mediation, delay, improvisational adaptation, or human sensemaking. Also, any situation of loose coupling can involve more than one form, and these forms can change over time. However, these situations of loose coupling tend to stabilize over time into a form of loosely coupled equilibrium.

The maintenance of this loosely coupled equilibrium has a variety of direct effects on process integration, control, data quality, and knowledge worker satisfaction with the process. All forms of loose coupling appear to enable stability in some way.

The stability enabled through loosely coupled practices allows the enterprise system implementation to persist and be deemed successful, and thus maintain or improve the legitimacy of the organization both within and with outside resource owners. Enabled by this stability, the enterprise system does enable structural integration and the control of resources on an aggregated, organizational level, although complete integration and control are not necessarily evident on a local level.

Through this synthesis, we have provided a novel theoretical framework rooted in our study of NASA’s ERP implementation. Next we will briefly discuss the limitations of this study, and describe some implications for both research and practice.
Chapter 10  Limitations

As with any study, this research involves a number of limitations. As an effort to generate grounded theory about loose coupling from the case of NASA’s ERP implementation, and due to the unique context of NASA, as well as some of the choices in emphasis that we made, there are certain limitations and biases in our research. First, although our goal involves theoretical inference (i.e., analytic generalizability, Yin 2003) rather than statistical generalizability, we leverage a fairly extreme case. NASA is a government Agency on the one hand, and a radically innovative organization on the other. Very few organizations are likely subject to the indeterminacy and turbulence on the scale of NASA. Certainly for-profit corporations do not have the luxury of decades of development before delivering a product. However, the domains that we addressed arguably evidenced many commonplace features and we could see similar dynamics playing out in other organizations that have knowledge workers – certainly heavily institutionalized organizations such as other government agencies, hospitals, and universities (which are all increasingly engaging in enterprise system implementations) – but also the many corporations with engineers, scientists, salespeople, and other such organizational members that might benefit from loose coupling. An effort to test the propositions generated here would help understand the generalizability of our findings to other organizations.
Also, questions of reliability might arise, as there was only one coder. However, this was mitigated by re-coding the data several times. As these studies involve theory generation rather than theory testing, thoughtful, honest and thorough analysis – with a deep and intimate understanding of the data combined with rich, “thick description” presentations - should be sufficient to address many of the concerns associated with reliability (Silverman 2001).

Another limitation involves the validity of the findings, as the researcher brings a number of biases to the research. While this is unavoidable, one way to deal with this is to simply acknowledge those biases (Strauss & Corbin 1998). There is likely not enough space here to relay all of the biases that I bring to this research, but one particularly material bias involves a value judgment. During the first round of coding I was taken aback by the expectation that literal rocket scientists – people who were some of world’s most foremost experts on their topics - were expected to attend training, learn, and operate a fairly involved software program for procurement that they will rarely use. Similarly, I was amazed by the expectation in some interviews that project managers learn to run queries to get the data they need from the system. Throughout this research my investigation was tainted by my sincere belief that in these cases direct use of the system cannot possibly be beneficial for the organization. While I attempted to temper this judgment through detached analysis, the findings generally confirmed these presuppositions. While I am convinced that virtually anyone else looking at the data would agree that loosely coupling researcher and project manager activity from the system benefited all parties, I must admit to some biases on this front.
Beyond these broad limitations, there are specific limitations for each study.

In the first study (the meta-analysis), there is an issue of the double hermeneutic (Giddens 1984) – or in this case, triple hermeneutic. Actors interpret events, and then I interpreted this interpretation and present their findings in a research paper. In this study, I interpret these findings – essentially removing myself by three interpretations from the phenomenon of interest. Certainly with accuracy as a key goal, this removal from the organizational actions is a serious limitation. It can be mitigated by attempting to focus on interpreting quotations and direct accounts whenever possible in the published studies and treating my reading of the case presentations as ethnographic accounts of those presentations (Noblit & Hare’s 1988). Another limitation from viewing published studies is that I am asking different questions than the researchers. A researcher may overlook or fail to include points that are critical to my analysis, because it is not salient to their analysis. Therefore, I am dealing with partial, filtered data, and my inferences are without critical context. However, as this is an initial test of my framework, and intended to aid in evolving this framework, I believe the exposure to 16 different implementations across industries and geographies does compensate for the problems to some extent.

Similarly, a key problem in the second study involves the interpretation of interviews that were conducted to get at more general phenomena, and I am eliciting specific data from these open-ended interviews. Therefore, I am often faced with partial accounts that were not followed-up during the interviews. However, I
have full access to the interview transcriptions, and I have had an opportunity to revisit many of the informants in the third study. Besides this, NASA’s internal documentation is public record, and I have triangulated many of the findings, particularly contextual descriptions, with documents from governmental auditors, functional groups, and internal implementation teams to validate some of my findings on a broader scale.

An issue with the longitudinal third study involves reliance on the perspectives of others. Barley (1986) warns that longitudinal research that is based on the recollections of informants is suspect, and in the case of this research, constructions of the incidents in T3 are largely retrospective constructions. While this is certainly a limitation, I feel that in interviewing thirty of the same informants twice, out of a total sample of 110 interviews, we were able to triangulate a bit on some of the incidents and thus overcome some of the limitations associated with recollection. Further, our unit of analysis was not the micro-activities where ethnographically-oriented interpretive research generally focuses. Rather, ours focused on broader organizational processes using a hermeneutic form of inquiry (Boland 1985), with the interview transcriptions and NASA documents as the text. Therefore our propositions depended vitally on the way individuals made meaning. So our research is subject to the validity issues relating to the double hermeneutic (Giddens 1984) associated with such research - informants making meaning of their experience-as-text, then our analysis of their sensemaking.
Another limitation of the research is that in the presentation we focus only on incidents of loose coupling, and these incidents of loose coupling involve “peripheral” process participants, in that scientists and project managers are not primary users of the system, but knowledge workers who would only use the system part-time at best. While there was a great deal of tight coupling evident in the data, this was not the focus of our research and would not help us address our research questions. So the many lessons we may have learned from focusing on them (perhaps from a counter-factual perspective) must wait for a future research opportunity. Also, by focusing only on these peripheral participants, we did not gain insight into loosely coupled activities of key, full-time users of the system (such as accounts payable clerks or financial analysts). While we interviewed a number of such people, and their data informs our research from a contextual standpoint, it was not addressed in the analysis presented here. The outcome of this trade-off is that our analysis primarily applies to the part-time, peripheral, or knowledge worker form of enterprise system user. For our overall argument, however, this is precisely the population of interest in determining the impacts of loose coupling on overall system success, as these users tend to be key originators and consumers of enterprise system data. Further, if one is interested in impacts of enterprise systems on issues like innovation, these are precisely the users that would apply.

A final limitation is concerned with the limited presentation of potentially alternative explanations in the theoretical development. Certainly from reading this document it may look like I entered the analysis with an institutional perspective in mind, and then found what I was looking for. In actuality, however, I did not even
consider institutional theory until it was suggested by my advisor (Kalle Lyytinen) and a colleague (Josh Whitford) when I described to them what I was seeing. Until that point I was attempting to make sense of this data by enlisting a variety of lenses including Foucault’s view of demonstrative control. After proposing this research, one of my committee members suggested that I seriously consider incentives and economic theory in my analysis, and I embarked upon reading a good deal of economic institutional literature including Williamson (1975; 1985; 1993); Nelson & Winter (1982); North (1991); and Langlois (1986). From this reading I came away convinced that sociologists from the cognitive tradition and institutionally-minded economists are not that far apart – both allow for the possibility of rational human computation (of course, the bounded and embedded form), and both appreciate human inconsistencies and agree that rational computation is not the only motivation for human behavior - they generally depart on emphasis, research questions, and nuances (such as pragmatic views of human inconsistency, Whitford 2002, for example). For the purposes of this study, the institutional logics behind the actions are found to be quite salient. If I look at these logics as the result of rational calculation, I do not know what I would gain, but I lose the link to society's broader institutions, which I believe offers some explanatory power. Suffice it to say that in this exercise of theory generation, I did sincerely explore other theoretical frameworks, but none fit as snuggly as the lens of institutional logics. Further, I believe my appropriation of the concept of institutional logics in a context of institutional plural organization can contribute to a variety of streams of research, which, among other contributions, will be addressed in the following section.
Chapter 11  Contributions

Rarely do information systems researchers adopt an institutional perspective, and when they do, it does not extend to the level of the individual practices that are guided by society's broader institutions (Orlikowski & Barley 2001). Instead, information systems research practices are consistent with the bulk of institutional theory, where organizations influence and respond to their environments as singular, homogenous actors (e.g., Oliver 1991). The institutional plurality within organizations goes under-theorized and largely unaddressed, although such a view can do much to improve our understanding of organizational dynamics (Kraatz & Block 2008). Further, while the device of an institutional logic is intended specifically to enable multi-level theorizing (Friedland & Alford 1991), such theorizing that pierces the boundaries of an organization by appropriating this device is rare (Thornton & Ocasio 2008).

Therefore, this research is the first body of work to take an institutionally pluralistic view of an organization; map local institutional structures that guide practice to named societal institutions through the device of an institutional logic; adopt Oliver's (1991) framework of institutional responses within organizations; and simultaneously address the practical, institutional, and material aspects of the appropriation of an enterprise information system within an organization. This
novel, complementary combination of theoretical perspectives has the potential to inform broad a variety of literatures. For example, in identifying (naming) relevant social structure through an institutional logic, a structurationist researcher can overcome some of the limitations associated with applying structuration to organizational settings (Jones & Karsten 2008). In a much different example, institutional logics might provide a set of tractable assumptions, or a situation, from which to analyze organizational behavior for those looking to study the regularities borne of (bounded) rationality (Langlois 1986; Williamson 1993). Another broad application might involve the study of organizational change through evolutionary routines (Pentland & Feldman 2003), where the conflict of institutional logics can complement the forces of selection and retention (Nelson & Winter 1982). In each of these cases, not only can the institutional perspective depicted in this thesis inform each of these bodies of work, but this perspective in some ways makes these works more applicable to the information systems domain (as evidenced by the appropriation reported herein of Pentland & Feldman's view of processes, through the operationalization provided by Volkoff et al 2007).

Another key contribution of this research is the operationalization of the concept of institutional logics. In eliciting and defining the four key dimensions of institutional logics (principles, assumptions, identities, and domain, see Table 1), this work provides a framework for both researchers and practitioners to use to understand and compare local practices, and get at the institutional order associated with those practices.
For the body of research concerned with loose coupling, this research provides a
detailed example of loose coupling associated with business processes. While loose
coupling in this domain has been addressed both explicitly (e.g. Snook 2000) and
implicitly (Pentland & Feldman 2005; Volkoff et al 2007), the level of detail
presented here specifically for the purposes of understanding loose coupling over
time enables us to develop a specific theory of loose coupling for enterprise system
implementations. Through this theory we make a number of assertions, and the one
that may be particularly novel to researchers who study loose coupling is our
observation that loose coupling on a local level enables tight coupling on a higher
level. This view complements the literature that has indicated that tight coupling on
a local level – of activity with systems or standard processes – can enable loose
coupling on organizational (Sanchez & Mahone 1996; Snook 2000) and
interorganizational (Boland et al 2007) levels.

Next I will address specific contributions of this research to information systems
research and practice.

10.1. Contribution to Information Systems Research

This dissertation involved an effort to generate theory. While the specific ways that
each study impacts relevant research are addressed in each respective appendix,
following is a reflection on some key ideas highlighted in this research.

First, the drivers of acceptance, diffusion, or appropriation of information
technologies in organizations continue to be a central concern for information
systems researchers. Researchers often study the effects of individually-focused variables on system use (e.g., Davis 1989; Venkatesh et al 2003). These studies, while quite successful in predicting system use, do little to improve our knowledge about how systems are used. The studies that do focus on how systems are used, tend to focus on situated, idiosyncratic appropriation of such systems (e.g., Barley 1986; Orlikowski 1996) – although this appropriation of technology draws upon local social structures and often triggers changes to these structures, the structures are fundamentally located within the boundaries of the organization and are intensely local. On the other hand, much of the diffusion literature, particularly those studies that take an institutional perspective (e.g., Damsgaard & Lyytinen 2001), see the key to organizational appropriation of information technologies within their institutional fields. No studies, to date, connect these two perspectives. Through the simultaneous use of the lenses of institutional logics and institutional pluralism, in this study we provide a theoretical device to enhance each of these perspectives. For acceptance studies, the notion of institutional logics offers a mechanism through which rational explanations of individual behavior can be contextualized. For idiosyncratic appropriation studies, the lens of institutional logics enables researchers to put a name to the social structures that individuals draw upon to guide their actions and tie these social structures to broader institutional fields and sectors of society, and thus reaching beyond the immediately local context to appreciate regularities across contexts. Finally, for diffusion studies, the ideas of institutional pluralism and institutional logics open the “black box” of organizations to make sense of different parts of the organization and thus
differentiate between the types of diffusion within different organizations. This understanding of different appropriation patterns in organizations is especially relevant, given the presence of loose coupling.

Also, while researchers have described situations of loose coupling in the wake of an enterprise system implementation (Wagner & Newell 2004; Pollock & Cornford 2004), this loose coupling is not established within a solid, understandable and readily-operationalizable framework. By extending Volkoff et al’s (2007) framework we provide a precise and comprehensive vocabulary for distinguishing across types of loose coupling.

Further, through our characterization of certain misalignments, such as when performative aspects do not align with other performative aspects of a process, we add another dimension to discussions of materiality in the context of enterprise system research – the activities that take place outside of the interaction with the system. Whether the research emphasizes softly deterministic properties of the system – where the material aspects of the system bends relevant practices to their will (i.e., Gosain 2004; Kallinikos 2004; Volkoff et al 2007), or whether the research emphasizes the limits of enterprise systems and the free will, agency, and unintended consequences on the part of the users (Boudreau & Robey 2005; Ciborra 2000), the assumption inevitably take the following form: if successful, the enterprise system is actually being used within the process. Through the evidence of stable states of loosely coupled equilibrium, this research seriously questions this assumption.
The combination of the lens of institutional pluralism (Kraatz & Block 2008) and the theoretical device of an institutional logic that ties local activities, as well as the materiality of the system, to society's broader institutional struggles offers a powerful alternative to the study of materiality and agency in a vacuum. This combination enables researchers to avoid the deterministic arguments that are often associated with materiality (Leonardi & Barley 2008), but also to avoid the solipsistic implications of arguments that chalk up all idiosyncratic appropriation of information technologies to the unpredictable situatedness of practice. Through this lens, we do identify some regularity, and this regularity has some implications for the stratification of organizational actors.

Our use of institutional logics offers an alternative theoretical lens for stratifying organizational actors, beyond functional groups (e.g., Lawrence & Lorsch 1967) or communities of practice (Wenger 1999). Our analysis indicates that the assumption of group uniformity – either through functional groups or communities - may not be sufficient for pluralistic organizations (Kraatz & Block 2008). The lens of institutional logics allows for differentiation within groups of responses to new enterprise systems, and also allows for differentiation within individuals in their responses to the system’s role in different practices, as different practices of the same individual may be guided by different institutional logics.

We highlight how a focus on the level of practice – rather than that of organizational groups or entire organizations – may be the appropriate level of analysis for understanding user responses to enterprise system implementations, given the
power of individual human agency (Boudreau & Robey 2005) and the all-
encompassing nature of enterprise systems. By identifying the institutions that an
individual draws upon to guide specific practice researchers may be able to better
understand individual responses to enterprise systems. In our analysis, we found
that inconsistent institutional logics did result in misalignments, consistent with
Gosain (2004) and Sia & Soh (2007), but these institutional theorists indicated that
in order for this misalignment to be resolved, either the enterprise system must be
customized, or the organizational practices must be adapted to the system. In the
NASA case, we found four instances of loose coupling where this tightly coupled
alignment is not evident, but instead we found stable situations of loose coupling
that enabled the stability of the enterprise system implementation.

Through this analysis we find that appropriation at a local level is non-uniform
across a single organization, indicating that research that addresses dominant
institutional logics associated with information systems implementation (Gosain
2004; Currie & Guah 2007) focus primarily on a subset of organizational practices.
While such analyses may capture dynamics of overall organizational change, this
research calls attention to the non-uniformity and potential incompleteness or
superficiality of change in the context of local practices.

Perhaps one of the most important implications of this research involves the
complex interaction of the key outcomes generally associated with enterprise
systems – integration and control – and the relationship of these outcomes with the
notion of stability. While our findings show that on a local level stability may occur
at the expense of integration and control, this stability enables enterprise system success at the organizational level, which fosters integration and control at a higher, overall process level of detail. Loose coupling of processes with the system enables the success of a tightly coupled enterprise system, which, in turn, preserves some loose coupling of organizational structures. Further, in the domain of practice, integration and control are often positively related, but can also be negatively related or orthogonal. Our analysis begins to get at some of the dynamics associated with these phenomena, but this is just a beginning and needs to be refined through future research. The interaction of stability, control, and integration, on multiple levels of the organization, is not a straightforward problem.

Finally, it is important to assess the methodological and descriptive contributions of the research. In the application of a novel technique for the analysis of published, interpretive case studies (Noblit & Hare’s 1988), this work has blazed a new methodological avenue in information systems research. As interpretive accounts of organizational phenomena are enjoying unprecedented levels of acceptance and publication, a pool of diverse, richly descriptive primary data is made increasingly available to test theoretical propositions, to synthesize interpretive perspectives, or to generate new theory. Further, it is hoped that by making the rich description of NASA data available in this study, we enable another researcher in the future to leverage our work for purposes of his or her own. The final set of implications from this research involves the implications for practicing managers, which are addressed in the next section.
10.2. Implications for Managers

The key contributions of this research for practitioners involve the causes and effects of loose coupling. First, practitioners must acknowledge all-too-common situations where business processes in reality are loosely coupled from the way these processes are documented and implemented through the system. The data in the enterprise system often does not reflect what it is supposed to reflect. People do all kinds of things to project a façade of compliance and regularity to their messy, non-compliant actual lives (see examples of the NASA budgeting process and researcher time keeping in Appendices 2&3). Although it may even seem obvious that such things are common, it is surprising how often practitioners carry on as if the data in the system really does reflect organizational activity.

Once this potential for loose coupling is realized, the idea of an institutional logic (perhaps the term “logic of action” would be more approachable, although it loses the tie to broad institutions) helps understand the causes of this loose coupling. Davenport (1998) cautions organizations to be wary when implementing an enterprise system, because such systems imply specific organizational forms and styles of management. If overlaid onto an organization that does not fit these forms and styles, the system can cause problems. By assessing the logics of action within their organizations, managers may see where the likely locales for loose coupling may be. Even if managers just did superficial functional assessments of logics of action across sales, engineering, customer service, and accounting, they would likely
find four qualitatively different logics present. Not all of these logics are likely to be congruent with that of the system.

This lens emphasizes the possibility of loose coupling. Once that is appreciated, it offers managers a tool for identifying likely locations for loose coupling. The next step is, what do they do about it?

While the instinct of a manager, as well as the prevailing conventional wisdom, suggests that any loosely coupled misalignments between activity and the system be aligned or "fixed," it is important that practitioners reflect before pouring resources into such a fix. This research shows that loose coupling may be desirable in many situations. Loose coupling tends to support system stability, which is critical to the success of enterprise systems and the legitimacy of the organization. The analysis of NASA offers a concrete example where the local responses to the enterprise system were rife with loose coupling, but the overall financial integration between centers was quite successful, and organizational activities were brought into line with the new strategic objectives of the President's space vision largely in conjunction with the enterprise system. Further, loosely coupled stability in business processes appears to increase the satisfaction of knowledge workers with the system. Attempts to align loosely coupled situations may exacerbate problems with the integration or control of the process, so should be pursued cautiously. Also, practitioners must acknowledge the possibility of poor data quality – where the data in the system simply does not capture what it is intended to capture – in guiding their view of loose coupling.
Chapter 12      Conclusion

As organizations spend hundreds of billions of dollars on enterprise systems, it is imperative that they understand the notion of loose coupling and its applications in this domain. Loose coupling can foster innovation, can render ERP data meaningless, can provide a space for individual flexibility, and can undermine accountability. This research is step toward understanding the value as well as the challenges of loose coupling in enterprise system implementations.
Appendix A - An Institutional Analysis of Pluralistic Responses to Enterprise System Implementation *

Abstract

Organizations are awash in a wide range of practices that are guided by a variety of goals, values, assumptions, and identities. New enterprise systems are consistent with many of these practices, yet conflict with others. Using institutional theory, we show how the congruence with the institutional logics associated with an ERP implementation affects the local responses to the system. This institutional logic is often accompanied by strong institutional pressures whereby actors can respond either with strategies of acquiescence such as compliance or mutual adaptation, or with loose coupling strategies of compromise and avoidance. We conducted a qualitative meta-analysis of eighteen published case studies of ERP implementations. The results support our theoretical conjectures. The findings suggest that situations involving loose coupling call to question the validity of enterprise system data. We also highlight the limited role of resistance strategies as viable long-term responses.

*Note: An earlier version of this paper was presented at the 2007 International Conference of Information Systems: Berente, N., Lyytinen, K. and Yoo, Y. (2007) "An Institutional Analysis of Pluralistic Responses to Enterprise System Implementations,” International Conference on Information Systems, Montreal, Quebec, Canada, December 9-12, 2007
An Institutional Analysis of Pluralistic Responses to Enterprise System Implementation

Introduction

Information technologies have been characterized as triggers for organizational structuring (Barley 1986), as “carriers” of institutional structure (Scott 2008), and as a form of structure in themselves (Orlikowski 1992; DeSanctis & Poole 1994; Gosain 2004). Introduction of a large information system into an organization can become disruptive, when “structures” carried along with the system conflict with the existing structures in the organization. Research into technology adaptation (Leonard-Barton 1988; Orlikowski 1996; Majchrzak et al 2000) does not, however, address situations where the structures associated with IT are incongruent with the goals, values, assumptions, and identities incumbent in the organizational setting. This is particularly problematic for enterprise system implementations such as enterprise resource planning (ERP), where a large scale systemic infrastructure is expected cut across a broad variety of idiosyncratic organizational routines (Ciborra 2000). An organization is not made up of a single homogenous set of routines and practices. To the contrary, it is a nexus of diverse, and often conflicting, routines and local practices. Although many researchers allude to similar conclusions, this issue has not been explicitly addressed in the ERP systems literature: What are the responses of specific groups and individuals to an enterprise system, the structure of which is inconsistent with localized routines and structures? Furthermore, why
does resistance rise in situations where systems are consistent with existing practices?

To address these questions, we draw upon institutional theory (Gosain 2004; Soh & Sia 2004). In general, institutional theory offers a theoretical lens for analyzing goals, values, and prescriptions that underlie and legitimate behaviors of groups and individuals (Powell & DiMaggio 1991). We conceive of an organization as a nexus of nested institutions, some of which are compatible, while others conflict (Meyer & Rowan 1977; Powell & DiMaggio 1991; Bacharach et al 1996; Crouch & Farrell 2004; Whitford 2005). If in conflict, these institutions become loosely coupled (Meyer & Rowan 1977). Each institution in turn can be characterized in terms of the “institutional logic” of its structures (Friedland & Alford 1991; DiMaggio 1997): the symbolically-grounded organizing principles that underpin individual action – both the means and the ends of those actions - in a manner consistent with a given institution (Friedland & Alford 1991).

When a given ERP system embodies a specific institutional logic, and organizations are made up of a diverse set of individuals and groups with incongruent and loosely coupled institutional logics, one can expect an enterprise system to be congruent with some institutional logics, and be incongruent with a host of others. We formulate a theoretical framework to distinguish and analyze varying levels of congruent and incongruent logics and associated responses to ERP implementation by drawing upon the institutional theory of Oliver (1991) and Goodstein (1994). We propose that given a high degree of force behind the introduction of a new
enterprise system, actors will engage in a variety of typified responses – from compliance to loose coupling - in accordance with the extent of congruence between the institutional logics that guide their everyday routine and those of the proposed enterprise system. This suggests that an organization's response to an ERP implementation will be more pluralistic and complex than singular and homogeneous responses that are often characterized in the literature. Therefore, it is not a matter of success or failure, but rather how diverse responses in an organization emerge and how managers can anticipate and manage such diverse responses. Our goal in this paper is to provide a theoretically driven framework and validate it based on a meta-analysis of published case studies of ERP implementations.

Next we will introduce the notion of an institutional logic and formulate an institutional framework that organizes local responses to a new ERP system based on its congruence with the logics of existing routines, and the force by which it is introduced. We then apply this framework to 16 published case studies to analyze to what extent the responses to system implementations could be explained by the framework. The paper concludes with a discussion of implications for research and practice.
An Institutional Perspective

While the bulk of institutional studies focus on macro-level phenomena governing industries, sectors, and fields, with organizations viewed as the smallest level of actor (e.g., DiMaggio & Powell 1983), Powell and DiMaggio (1991) caution institutional researchers that any macro-level phenomena can find their roots in micro-level human action. Drawing upon Bourdieu's (1977) notion of habitus, Powell and DiMaggio describe internalized rules that are chronically reproduced by individuals through everyday action, yet generative in nature, as the foundation for conceptualizing institutions.

We view an institution simply as “an organized, established, procedure” (Jepperson 1991, p.143). The term “organized” implies structure, and “established” implies history and persistence. This procedure, when reproduced consistently, generates specific patterns that guide the actions of individuals through their rule-like qualities, and which individuals draw upon to establish and maintain their identities (Jepperson 1991). Institutions are nested within each other – from individual micro-practice to supra-organizational patterns of activity – and these institutions can be complementary or contradictory (Friedland & Alford 1991).

When scholars address societal or industry-level topics, they often treat organizations as “homogenous, internally isomorphic” actors (Crouch & Farrell 2004, p.32). This organizational unit of analysis is generally how the IS literature treats institutions (King et al 1994; Robey & Boudreau 1999; Ang & Cummings 1997; Damsgaard & Lyytinen 2001; Liang et al 2007). However, when addressing
issues within individual organizations, a richer institutional view is in order
(Friedland & Alford 1991). While some organizations can evolve to institutional
status in and of themselves, most do not (Scott 2008). Still, organizations are
typically portrayed as uniform, singular entities in institutional theory, while
organizations are in fact typically made up of many fragmented, contradictory, and
incoherent patterns of activity (Bacharach et al 1996; Crouch & Farrell 2004;
Whitford 2005). These inconsistent institutions can coexist within the same
organization through decoupling (Meyer & Rowan 1977).

**Institutional Logics**

Individuals within organizations, thus, draw upon a variety of institutions to guide
their actions. Each of these institutions can be said to have its own “institutional
logic,” or rather:

*The logic associated with an institution is* a set of material practices and symbolic
constructions – which constitutes its organizing principles and which is available to
organizations and individuals to elaborate... These institutional logics are
symbolically grounded, organizationally structured, politically defended, and
technically and materially constrained. (Friedland & Alford 1991, p.248-249)

It is important to stress that these logics can be fiercely defended, as institutional
logics are fundamental components of individual's identity: “The routines of each
institution are connected to rituals which define the order of the world and one's
position within it, rituals through which belief in the institution is reproduced.”
(Friedland & Alford 1991, p.250)

While Friedland & Alford (1991) focus on institutional logics of broad, societal level institutions (i.e., capitalism, the state, democracy, family, religion, science), DiMaggio (1997) indicates that the idea of institutional logic is consistent with the micro-level concept of “logics of action.” A logic of action can be defined as an “implicit relationship between means and ends underlying the specific actions, policies and activities of organizational members. While the logic of action is for the most part taken for granted, it becomes manifest when parties try to explain to themselves or justify to others the selection of specific means, ends, and the linkage between the two” (Bacharach et al 1996, p.478). DiMaggio (1997) states that the device of institutional logic / logic of action is useful to researchers for the following reasons:

First, it proposes that external rituals and stimuli interact with internal mental structures to generate routine behavior. Second, it is consistent with the view that culture is fragmented among potentially inconsistent elements, without surrendering the notion of limited coherence, which thematization of clusters of rituals and schemata around institutions provides. Third, it provides a vocabulary for discussing cultural conflict as confrontation between inconsistent logics of action. (DiMaggio 1997, p.277)

Individuals can be expected to cling to the institutional logics that have guided their actions and given them meaning in the past, and they will not easily move to new, conflicting, institutional logics (Thornton 2002). When presented with the force of a new, conflicting institution, for example, in the form of prescriptions from upper management, actors can be expected to experience dissonance that makes
exchanges between different local groups difficult (Bacharach et al 1997). To address this dissonance, local actors have a number of potential strategies in responding to new institutional logics, and this understanding of dissonance and conflict is essential to our analysis of a range of responses to a new enterprise system.

**Response to Institutional Logics**

Institutional theory has been criticized for painting organizations and actors as passive recipients of institutional forces (Powell & DiMaggio 1991; Scott 2008; Oliver 1991). To remedy this problem, Oliver (1991) identified five broad categories of organizational responses to institutional forces (in order of progressively more resistance to the institutional pressure): acquiescence, compromise, avoidance, defiance and manipulation (see Table 1 for definitions). These could be organized after Goodstein (1994) based on the congruence of logics with one another (congruent / incongruent), and the level of institutional pressure to follow the new institutional order (strong / weak).

Oliver's (1991) theorizing treats organizations as single actors. As discussed above, however, while this might make sense for institutional analyses that study industries or fields, we draw on the pluralistic view which holds that organizations are the intersection of multiple, nested institutional logics (Meyer & Rowan 1977; Bacharach et al 1996; Crouch & Farrell 2004; Whitford 2005). In a particular
location within an organization, therefore, a new institutional logic may or may not come in conflict with the existing order. If they conflict, it will likely result in loose coupling between the existing practice and new institutional requirements (Meyer & Rowan 1977), resulting in different configurations and relationships among local practices. Such reconfigurations among local practices then can transpire, setting off a wave of unanticipated changes among other adjacent local practices, producing change at the organizational level. This suggests that the implementation of an enterprise system can have much more complex and dynamic consequences than what is often described in the literature, when we look at it from a pluralistic perspective, taking the idiosyncrasy of local practices into account.

<table>
<thead>
<tr>
<th>Response strategies</th>
<th>New institution (adaptation of Goodstein 1994)</th>
<th>Definition</th>
<th>Forms of response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquiescence</td>
<td>Strong pressure; logics congruent</td>
<td>Conformity to institutional prescriptions and implied social order.</td>
<td>Habit (unconscious, passive) Imitation (mimetic isomorphism) Compliance (conscious obedience)</td>
</tr>
<tr>
<td>Compromise</td>
<td>Strong pressure; logics incongruent</td>
<td>“Partial conformity” to explicit institutional prescriptions without necessarily the implied social order.</td>
<td>Balance (parity among multiple interests) Pacify (conform to minimal standards) Bargain (extract concessions for conformity)</td>
</tr>
<tr>
<td>Avoidance</td>
<td>Strong pressure; logics incongruent</td>
<td>“Partial conformity” to either a portion of the institutional prescriptions or none at all.</td>
<td>Concealment (disguise conformity) Buffering (reduce scrutiny, decoupled) Escape (exit domain in which pressure exerted)</td>
</tr>
<tr>
<td>Defiance</td>
<td>Weak pressure; logics incongruent</td>
<td>Non-conformity with a portion of the institutional prescriptions within the applicable domain.</td>
<td>Dismissal (ignore institutional rules) Challenge (actively challenge institution) Attack (intense and aggressive challenge)</td>
</tr>
<tr>
<td>Manipulation</td>
<td>Weak pressure; logics congruent</td>
<td>Actively direct the institutional prescriptions.</td>
<td>Co-opt (take ownership of the source) Influence (“manipulation of belief systems”) Control (“struggles for power”)</td>
</tr>
</tbody>
</table>
Goodstein (1994) extended Oliver’s (1991) analysis by indicating that the form of response chosen will also be influenced by the anticipated effect of these institutions on “technical outcomes.” Inherent in Goodstein’s (1994) analysis, however, is again the assumption that rational action associated with technical outcomes will guide responses universally across all contexts, which is not an assumption consistent with institutionalist thinking (Goodrick & Salancik 1996). Individual discretion in the form of strategic response is constrained, or “bounded by the institutions that gave rise to it,” and therefore any response to institutional pressure must be consistent with existing institutions (Goodrick & Salancik 1996, p.2). Goodrick & Salancik (1996) remind us that technical outcomes are not always the fundamental concern of organizational activity, as institutions are guided by established norms and values. Based on this insight, we modify Goodstein’s (1994) focus on technical outcomes by focusing on congruence of the institutional pressure coming out of new logics with existing institutions. Our adaptation of the Goodstein (1994) framework leaves room for situations where a rational focus on specific technical outcomes is congruent with the guiding institutional logic, as well as those occasions when it is not.6

Following our adaptation of Oliver (1991) and Goodstein (1994), we suggest that when incumbent institutional logics are congruent with that of a newly introduced institution, and the force to comply is great, then local practices will eventually

6 Note that by reinterpreting Goodstein’s drivers as “congruence,” we are equating this with Oliver’s “content.” Although his notion of pressure initially appears to embody all of Oliver’s constructs, we choose to focus on “control” as this directly equates to Goodstein’s operationalization.
comply with the new institution, or “acquiescence,” which subsumes responses such as habit, imitation, or conformity (Oliver 1991). If, however, this newly introduced institutional logic is incongruent with that of local practice, and yet the force to comply is great, then responses will involve “partial conformity” in the form of compromise or avoidance, which together represent the “thin edge of the wedge in organizational resistance” (Oliver 1991, p.153). These tactics for partial conformity range from “concealing their nonconformity, buffering themselves from institutional pressures, or escaping from the institutional rules or expectations,” to “disguising nonconformity behind a façade of acquiescence...”, “window dressing”; ritualism; ceremonial pretense; or “symbolic acceptance of institutional norms, rules, or requirements” (Oliver 1991, p.154). Only if the pressure through which the new logic is introduced is weak can outright resistance strategies, or the “defiance” of ignoring or fighting the institution, be possible. Finally, if the new institution is introduced without a great deal of pressure, yet it is congruent with the logic of existing practice, then the response can involve “manipulation” or control of the newly introduced institution. Next we will synthesize this institutional framework with common responses to IT implementation to create an institutional framework of responses to enterprise system implementations.

Institutional Response Framework for IS Implementation

There has not been a great deal of research on enterprise systems using an institutional lens. Two exceptions include Gosain (2004) and Soh & Sia (2004). In
both cases, enterprise systems are characterized to embody a specific institutional logic.

<table>
<thead>
<tr>
<th>New institution embodied by IS</th>
<th>Response strategies - Oliver 1991</th>
<th>Local responses to information system</th>
<th>Sampling of applicable IS literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong pressure; logics congruent</td>
<td>Acquiescence</td>
<td>Process adaptation; system configuration</td>
<td>Leonard-Barton 1988; Tyre &amp; Orlikowski; Majchrzak et al 2000; Soh &amp; Sia 2004; Davenport 1998; Markus et al 2000; Boudreau &amp; Robey 2005; Orlikowski 1992; DeSanctis &amp; Poole 1994</td>
</tr>
<tr>
<td>Strong pressure; logics incongruent</td>
<td>Compromise / avoidance</td>
<td>Process adaptation; system customization; improvisation, resistance</td>
<td>Ciborra 2000; Pollock &amp; Cornford 2004; Scott &amp; Wagner 2003; Wagner &amp; Newell 2004, 2006</td>
</tr>
<tr>
<td>Weak pressure; logics incongruent</td>
<td>Defiance</td>
<td>Resistance</td>
<td>Keen 1981; Markus 1983; Lapointe &amp; Rivard 2005</td>
</tr>
<tr>
<td>Weak pressure; logics congruent</td>
<td>Manipulation</td>
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</tr>
</tbody>
</table>

Organizations that respond to the introduction of the new enterprise system are conceived as singular actors, where the institutional forces embodied by the system are not in alignment with that of the organization (Soh & Sia 2004; Gosain 2004). In one case, while organizations are acknowledged to contain multiple stakeholder groups, the “misfit” between the institutional logic of the system is set in opposition to the “dominant institutional logics” associated with the organization (Gosain 2004, p.167). We view organizations to be awash in multiple, nested institutional logics, and need, therefore, to dig beneath the surface view of an entire organization’s harmonious adaptation and instead focus on specific responses associated with particular routines. Table 2 below combines the adaptation activities that are prevalent in information systems implementation literature with our application of
Oliver’s (1991) institutional analysis of responses in Table 1. Many of Oliver’s descriptions are consistent with concepts recognized in the literature, and we have matched these descriptions respectively.

Of these strategies, acquiescence has been addressed at length in information systems literature and we have a wide array of studies of mutual adaptation (Leonard-Barton 1988; Tyre & Orlikowski; Majchrzak et al 2000; Soh & Sia 2004), technology adaptation (Orlikowski 1992; DeSanctis & Poole 1994), and enterprise systems (Davenport 1998; Markus et al 2000; Boudreau & Robey 2005). In contrast, lack of acquiescence, or defiance (and some forms of avoidance), are usually framed in terms of “resistance,” and this concept also has a rich follow-up in the IS literature (Laponte & Rivard 2005; Markus 1983; Keen 1981). Some attention has also been paid to compromise and avoidance quadrants (Ciborra 2000; Pollock & Cornford 2004; Scott & Wagner 2003; Wagner & Newell 2006).

In an effort to further explore the relationship between various adaptation activities in the wake of an enterprise system implementation, we will next operationalize our theoretical constructs and apply them in order to analyze a sample of published case studies on ERP implementations, in an effort to understand how documented response strategies in the wake of an enterprise system implementation matched with the institutional logics at play.
Operationalization of the Framework

In order to appreciate the clash of incongruent logics, and thus operationalize the concept, we apply the following four dimensions of an institutional logic that have been recognized in the literature (Table 3). First, institutional logics act as organizing principles that guide activities, and thus embody the goals and values of the institution (Friedland & Alford 1991). Second, institutional logics are founded on assumptions associated with specific causal means-end relationships (Bacharach et al 1997). Third, institutional logics form local identities (DiMaggio 1997; Friedland & Alford 1991; Jepperson 1991; Thornton 2002). Fourth, institutions are more and less salient to specific domains and their practices (Jepperson 1991; Powell & DiMaggio 1991).

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles</td>
<td>Goals and values of the institution</td>
<td>Friedland &amp; Alford 1991; Thornton 2002</td>
</tr>
<tr>
<td>Assumptions</td>
<td>Understanding of causal means-end relations</td>
<td>Bacharach et al 1997; Friedland &amp; Alford 1991</td>
</tr>
<tr>
<td>Identity</td>
<td>Individual or group identities implied by practices guided by the institution</td>
<td>DiMaggio 1997; Friedland &amp; Alford 1991; Jepperson 1991; Thornton 2002</td>
</tr>
<tr>
<td>Domain</td>
<td>Context or specific practices associated with the institution</td>
<td>DiMaggio &amp; Powell 1991; Jepperson 1991</td>
</tr>
</tbody>
</table>

The institutional logic for an ERP system is represented quite uniformly in the information systems literature. Adopting the four dimensions of an institutional logic identified above, Table 4 summarizes the institutional logics associated with ERP. The enterprise system can be seen to embody a specific “technological
imperative” (Davenport 1998); rationalized logic or structure (Sia et al 2002; Gosain 2004; Elmes et al 2005); or procedural focus (Soh et al 2003; Kallinikos 2004). The principles generally associated with the enterprise system are control (Ciborra 2000; Hanseth et al 2001; Sia et al 2002) and efficiency (Newell et al 2003; Kallinikos 2004; Elmes et al 2005). These objectives are met through standardization (Soh et al 2000; Newell et al 2003; Kallinikos 2004); visibility (Sia et al 2002; Elmes et al 2005); best practice (Markus & Tanis 2000; Soh et al 2003; Wagner & Newell 2004); and integration (Davenport 1998; Markus et al 2000; Hanseth et al 2001; Soh et al 2003; Allen 2005). Enterprise systems are inscribed with assumptions inherited from reference industries and countries (Pollock & Cornford 2004; Soh & Sia 2004); managerial interests (Soh & Sia 2004; Gosain 2004); and historical industrial management trends (Webster 1991), which reflect bureaucratic, hierarchical administrative practices. Such practices are particularly well-suited to highly explicit procedures (Davenport 1998; Kallinikos 2004; Wagner & Newell 2004). Enterprise systems thus embody a logic that is well-articulated in information systems literature (Table 4).

<table>
<thead>
<tr>
<th>Table 4. Institutional logic commonly associated with ERP</th>
</tr>
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<tbody>
<tr>
<td><strong>Dimension</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Identity</td>
</tr>
<tr>
<td>Domain</td>
</tr>
</tbody>
</table>
Congruence of Institutional Logics

Within organizations, we anticipate the presence of incumbent institutional logics in local practices that are *incongruent* to that of the ERP system. Unlike the global organizing logics of contemporary organizations, these local practices may not be motivated by concerns of efficiency or control (Wenger 1998). They may not align well to standardization and integration, may resist rationalization, and may generally be less routine. Oliver's (1991) notion of consistency applies here, as she indicates that inconsistent institutions have different goals, and compliance with an inconsistent institution would reduce an organization's decision making discretion, and thus effectiveness. Goodstein's (1994) notion of “congruence” is concerned specifically with the “goals and policies” of the new institution, and if they can be accommodated while maintaining faithfulness to the goals and practices of the organization. DiMaggio (1997) thinks of conflicting logics as inconsistent cognitive schemata that are simultaneously applied to the same situation. As an indication of conflicting logics, Bacharach et al (1996) emphasize the “dissonance” that is felt by organizational actors in such cases that limits their ability to continue established practices.

Based on Oliver (1991), Goodstein (1994), DiMaggio (1997), and Bacharach et al (1996), we can conceive of two situations, where institutional logics can be congruent (1) the potentially inconsistent logics are applied to different domains, and thus never conflict; or (2) two or more institutional logics can be applied to the
same practices, and those practices can be guided by these logics without the dissonance. *Thus, we define incongruent institutional logics as those that are applied to the same domain and situation and cannot simultaneously guide the practices without fundamentally changing those practices.*

**Strength of Institutional Pressure**

As enterprise system implementations are often obligatory, we expect them to be introduced with great institutional pressure. Oliver (1991) indicates that the force of a new institution can be assessed by the degree of coercion, enforcement, vigilance, and sanctions associated with its (non) application. Oliver (1991) states that if the “consequences of nonconformity are highly punitive” (p.168), then the pressures associated with conformity are strong. Conversely, if conformity is strictly voluntary, these pressures can be considered weak. While Oliver (1991) emphasizes coercive forces, Goodstein (1994) adds to this the isomorphic pressures (DiMaggio & Powell 1983) that can be quite powerful. *In an organizational context, we define a strong institutional pressure to be involuntary compliance where significant, negative consequences are associated with nonconformity. Conversely, weak institutional pressures are those that allow voluntary adoption and offer no significant negative consequences for nonconformity.*

Therefore, in the case when enterprise system usage is not voluntary and implemented through strong institutional pressures, we expect to find the process
of mutual adaptation leading to eventual acquiescence (Leonard-Barton 1988; Orlikowski 1996). Accordingly, we postulate:

Conjecture 1: Given strong institutional pressures to conform, individuals whose local practices are guided by institutional logics congruent with that of an enterprise system will respond to the implementation of the enterprise system through mutual adaptation leading to eventual alignment.

Conversely, groups and individuals will respond to an enterprise system implementation that is incongruent with their practice through loose coupling when institutional pressure is strong:

Conjecture 2: Given strong institutional pressures to conform, individuals whose local practices are guided by institutional logics incongruent with that of an enterprise system will respond to the implementation of the enterprise system by loosely coupling their practices with the system through compromise or avoidance.

Practices maintain loose coupling from the ERP system through multiple mediating mechanisms that enable loose coupling. This implies ceremonialization, use of categorical (vs. technical) ends, and informal coordination (Meyer & Rowan 1977), that enable the informal to coexist with the formal, or the institutionally enforced activity to co-exist with only a superficial connection to a local activity.

Our first two conjectures are based on the assumption that compliance with enterprise systems are involuntary. In situations that the pressure is weak – i.e., voluntary adoption - we offer the following conjectures:
Conjecture 3: Given weak institutional pressures to conform, individuals whose local practices are guided by institutional logics incongruent with that of an enterprise system will respond to the implementation of the enterprise system with resistance.

Conjecture 4: Given weak institutional pressures to conform, individuals whose local practices are guided by institutional logics congruent with that of an enterprise system will respond to the implementation of the enterprise system with an attempt to manipulate / control the implementation.

Next we use these conjectures to test the implications and validity of the theoretical framework with twenty-four published case studies around ERP implementation.

**Research Method**

We chose qualitative cross-case “data-set observations” (Brady & Collier 2004) to conduct our meta-analysis across published, qualitative cases. Much like a cross-case statistical comparison of quantitative scores, qualitative data-set observations involve a rectangular data-set of process-oriented observations from independent cases – complete with variation on both the dependent and independent variables – in support of causal inference (Collier et al 2004).

We reviewed the enterprise systems literature after 1998, which is the date we identified as a beginning of the modern research stream on “enterprise systems” following Davenport’s seminal article (1998). Although there were enterprise systems before that time point, they were often tackled differently, in terms of “configurable” software (Fleck 1994), “packaged” software (Lucas et al 1988), and with more specific terms such as “advanced manufacturing technologies” (Webster
From 1998 onwards there is a cohesiveness within and momentum to the ERP literature. We reviewed articles from 1999 to 2006 in MISQ, ISR, JMIS, and EJIS that addressed enterprise systems. Next we traced their sources by snowballing citations, and thereby we obtained a database containing 147 articles on enterprise systems (mostly journal articles, but also several book chapters). The goal of our study is to identify and theorize around data about institutional logics – a goal that can not be addressed without a rich case description. Therefore, we chose to focus on “interpretive” case studies (Noblit & Hare 1988) – those informed by ethnographic, phenomenological, action research, or open-ended interview methodologies. From the total sample, we eliminated theoretical papers, prescriptive papers, and those involving factor and variance models and statistical analyses. We also had to eliminate additional positivistic case studies (e.g. Cotteleer & Bendoly 2006; Wei et al 2005; Sia et al 2002), as such studies did not lend themselves to the re-interpretation necessary for our purposes. Such a selective method of case selection is well suited for this type of qualitative meta analysis, as having a larger population in such cases does not necessarily translate to more robust results (Noblit & Hare 1988).
Table 5: Research Sample of Published Interpretive Case Studies

<table>
<thead>
<tr>
<th>Industry: sector</th>
<th>Country</th>
<th>Practice</th>
<th>Source</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Government: state agency</td>
<td>United States</td>
<td>order entry</td>
<td>Boudreau &amp; Robey 2005</td>
<td>interviews, observation, &amp; docs</td>
</tr>
<tr>
<td>2. Manufacturing &amp; services</td>
<td>United States / global</td>
<td>opportunity management</td>
<td>Ciborra &amp; Failla 2000</td>
<td>Interviews</td>
</tr>
<tr>
<td>5. Manufacturing: electronics</td>
<td>United States</td>
<td>purchasing, scheduling, inventory tracking</td>
<td>Allen 2005</td>
<td>ethnography</td>
</tr>
<tr>
<td>8. Pharmaceuticals</td>
<td>Sweden / global</td>
<td>study monitoring</td>
<td>Cordella &amp; Simon 2000</td>
<td>interviews</td>
</tr>
<tr>
<td>10. Services: engineering</td>
<td>&quot;Global&quot;</td>
<td>purchasing, engineering</td>
<td>Newell et al 2003</td>
<td>interviews, observation, &amp; docs</td>
</tr>
<tr>
<td>11. Services: financial services</td>
<td>New Zealand</td>
<td>accounting</td>
<td>Larsen &amp; Myers 1999</td>
<td>interviews &amp; documents</td>
</tr>
<tr>
<td>13. Services: maritime surveys</td>
<td>Norway / global</td>
<td>surveying</td>
<td>Rolland &amp; Monteiro 2002</td>
<td>interviews</td>
</tr>
<tr>
<td>14. University</td>
<td>United Kingdom</td>
<td>purchasing</td>
<td>Pollock &amp; Cornford 2004</td>
<td>ethnography</td>
</tr>
<tr>
<td>15. University</td>
<td>United States</td>
<td>purchasing</td>
<td>Lee &amp; Lee 2000</td>
<td>interviews &amp; documents</td>
</tr>
</tbody>
</table>

* Note that these two cases came from the same article

** These two articles have the same authors and identify the industrial products firm as "ACRO"

*** In these two articles, one author is the same and the university is identified as "Ivy"
Initially we identified a total of 31 articles from our literature review for our analysis. After more detailed analysis of the cases, our sample was further reduced to 17 articles. The other 14 articles were eliminated for a number of reasons, such as solely organizational level of analysis (e.g., Hanseth et al 2001; Soh & Sia 2004; Akkermans & van Helden 2002), or data that did not apply to our line of inquiry (e.g., Sawyer & Southwick 2002; Monteiro & Hepso 2000). Table 5 summarizes the 16 cases (across 17 articles) that were included in our final sample. Beyond the common characteristic that most of these organizations were quite large, we found a great deal of diversity. The cases ranged across industries, across the globe, and focused on different practices within organizations. Therefore we deemed this an adequate sample for a cross-case meta-analysis to initially validate our theoretical conjectures.

We coded the rich descriptions presented in the articles across six categories. The first four categories captured the four dimensions of the incumbent institutional logic - principles, assumptions, identity, and domain - with the goal of understanding whether this logic was congruent with that of the enterprise system. We only coded practices where a response to ERP implementation was explicitly narrated in the case description. The next category was for the strength by which the enterprise system was introduced. In general, we assumed the strength to be high – involuntary and strictly enforced – as we indicated above. However, we did find cases where the pressure was weak in relation to the incumbent logic. The final category of codes related to the form of response to the implementation: acquiescence, compromise, avoidance, defiance, manipulation. Next we will discuss our findings for each of these quadrants.
In a number of articles, incumbent institutional logics appeared to be congruent with the logic of the enterprise system. However, unproblematic, immediate acquiescence was not reported in any of the cases. Often, there was a period of mutual adaptation where either the system was customized, or practices changed, or both. Rolland & Monteiro (2002) provide an illustrative example of mutual adaptation borne out of congruent institutional logics. Surveyors in the field were presented with a system that was intended to standardize their data entry and automate surveying activity. While the software was not perfect for the application initially, the principles and assumptions associated with the software, which include higher efficiency based on standardization and process rationalization, for the domain appeared quite congruent with the principles of the supported activity. After all, the entire purpose of surveying activity [domain] is to “ensure compliance with classification rules and international regulations” [principles / goals] (p.92).

Before the introduction of the system, surveyors were also pursuing the goal of rationalizing their practices, as is evidenced by the point that "the surveyors had established a system of 74(!) different paper-based checklists for supporting different types of surveys" [assumptions of cause/effect] (p.92). While the software had a number of difficulties associated with its use, adoption was involuntary [strength of pressure] and therefore surveyors had to make it work – which they did over time with adjustments to both practice and the system. For example, initially
there were problems with the "Quick report" function of the system, so surveyors would delay its use. "In the later redesigns of the Surveyor Support System, however, the problem around the ‘Quick reports’ was solved by making it possible to make corrections in the final report."(p.96)

Similarly, materials management practices in a hospital context (Soh et al 2003) appear to require technical solutions combined with changes in practices before compliance can be effected. While the desire to control resources, what the authors describe as a “functional orientation”, impeded the adoption of the system, principles of standardization and efficiency guided the materials management practice. Therefore, mutual adaptation resulted in compliance with the system: “the implementation consultants were able to offer a workaround solution within the system that maintained the benefits of sharing a common database while accommodating the functional orientation of users. Some changes in workflow, however, were still necessary” (p.90).

Some case descriptions presented adaptation as a training issue, where, once understood, the enterprise system offered powerful benefits in congruent domains that centered on information access such as customer service and product inspection activities (Elmes et al 2005). In one example, adoption was described as unproblematic in relation to existing practices because all employees were displaced: “none of the original project team members were left in group accounting” (Larsen & Myers 1999, p.409). Other cases presented more problematic descriptions of mutual adaptation. For example, Ciborra & Failla
(2000) describe a situation where the enterprise system is congruent with the opportunity management domain, and was advocated in a powerful manner, with the CEO as the owner of the new process. However, the implementation took over four years to gain momentum, required incredibly high levels of training. Incentives did not always work and a complementary application finally gave the project the impetus to become widely accepted. Even after all of this, there was a “lack of compliance on all levels” (p.116) and an “uneven level of implementation” across the entire enterprise (p.117).

In a governmental context, order entry personnel, whose activities were routine and ostensibly compliant in principle with the enterprise system, initially avoided the system because they were given the option of avoiding it (Boudreau & Robey 2005). Once the pressure to comply was increased, the order entry personnel, through a mutual adaptation process of “improvisational learning,” acquiesced. The pressure to comply was intensified largely through coercive means, as a user indicated, "we were told that if we did not use the system, then we could be bumped out" (p.12). Also, "users recognized that departments whose transactions were processed [using the enterprise system] received faster service" (p.12).

In summary, when the institutional logic that guided the practice was congruent with the logic of the enterprise system, and the pressure by which compliance with the system is enforced is strong, acquiescence eventually takes place, typically through some mutual adaptation process. It is important to note that this acquiescence is not necessarily unproblematic, as it often takes a significant amount
of time, and that both of these forces (congruence and force) must be in place over
time to drive this acquiescence.

**Incongruent Logics, Strong Pressure**

Descriptions of involuntary adoption in the face of incongruent logics are also
prevalent in the literature. In his discussion of value conflicts associated with an
enterprise systems implementation, Allen (2005) describes a number of practices
that appear to be guided by institutional logics inconsistent with that of the
enterprise system. Most notable is the customer order process. While the system
implies a standardized, formal process for inputting orders, then putting them in the
queue for production, the goals of effective customer service [principal / goal] often
trumps this rationalization. According to one buyer/planner, “we have 12-14 week
lead times on many of our computer products. Customers can’t always give us that
much warning ahead of time. Often, we have to place orders for them in the system
before we get the official order. That's reality. We have to share the risk. Every
major account does this” (p.39). Based on this example, we can infer the logics that
guide their actions imply that standardized queues do not always lead to good
customer service [assumptions of cause/effect], and therefore buyer/planners, who
identify that “our priority number one is to support production and shipments”
(p.45), appear to be disguising their non-conformity by ostensibly using the system
appropriately, while in reality straying from the assumptions embodied by the system [partial conformity / loose coupling].

In another situation, “study monitors” [identity] who are responsible for managing pharmaceutical research projects [domain] are pressured to use a system that prescribes “structured and sequential data entry” (Cordella & Simon 2000, p.185). However, research activity requires a great deal of temporal and sequential variety [assumptions of cause/effect] and cannot be entirely planned in advance. Therefore, study monitors engage in what the author describes as “tinkering and improvisation” (p.189), but, by an example they give it may be better interpreted as partial-compliance. Study monitors were expected to be on-location, and to input the data themselves. Instead, “a typical situation would be monitors obtaining a copy of the paper-based [form] and entering the data at home… In one case, the monitor introduced extra pages into the [form], using carbon copies. Once the [form] was completed, the monitor collected the carbon copies and then paid external people to enter the data” (p.185). While this activity might be chalked up to “process adaptation,” it is clear that this activity is not consistent with the standard processes implied by the system.

Other examples abound of incongruent logics and strong pressures resulting in practices that are loosely coupled from those implied by the system. For example, nurses in a hospital were focused on patient care, and, although clerks enforced perfunctory use of the system, nurses would engage in patient scheduling activity outside of the system, only to reconcile it later (Soh et al 2003). In a university
context (Pollock & Cornford 2004), “centre administrators” were charged with purchasing, and they had to reconcile somewhat informal faculty procurement activities with that of the system’s rationalized process prescriptions, thus engaging in concealment activities that the authors describe as “Janus-faced” and “pretending to live with defaults”:

If the centre administrator was unavailable, which often happened, the other staff did not have an appropriate “login” or “user profile”, and thus could not generate the paperwork when it was needed. To circumvent this, a copy of the Enterprise order form was designed on a word-processor (available to print out at any time by the remaining support staff) and this was adorned not with the Enterprise order number but with what the staff called a “pseudo number” or “Secretarial requisition number”. Tickets could thus be ordered and the correct paperwork dealt with at a later date. (Pollock & Cornford 2004, p.43)

However, incongruence of institutional logics does not always appear to result in loose coupling. In a similar situation associated with another university's purchasing practices (Lee & Lee 2000), accounts payable personnel experience dissonance, as they perceived their jobs to be “deprived of meaning and responsibilities” (p.286) in the wake of a system implementation, and there was a “higher than expected turnover rate” (p.285). In the past, accounts payable people focused on individual areas, after the implementation they were expected to understand a wide range of accounting issues – their roles were then expanded to embody the auditing function in an attempt to enrich their activity.
Another example of incongruence that did not result in loose coupling is described in the case of two engineering practices of a manufacturer (Volkoff et al 2005). Their organization implemented an enterprise system that focused on automating the production process. Yet, engineers who originated much of the data for this process were concerned primarily with form and function of the products [principles / goals]. Many downstream activities were simply not salient to their task [assumptions of cause/effect], yet with the new system, they had to be concerned with these downstream activities to be compliant with the system in practices associated with engineering changes and bills-of-materials. In both cases, there appears to be sincere compliance reported on the part of the engineers, but this compliance was questionable, as it often led to delays and inaccurate information: “assembly operations were often held up because design engineering did not specify an engineering change either fast enough or in sufficient detail for assembly operations” (p.116).

In summary, as expected, incongruent logics associated with an enterprise system introduced with a strong institutional pressure lead generally to loose-coupling as a response. However, this was not always the case. As the case studies indicate, in one case the activity changed entirely (consistent with DiMaggio 1997), and in another it was rife with procedural and data problems.
Incongruent Logics, Weak Pressure

As expected, incongruent logics of enterprise systems introduced with weak pressure typically lead to initial resistance. However, it does not end there. This resistance can lead to either a wholesale rejection of the system, loose coupling similar to those associated with stronger pressure, or even eventual compliance over time.

Resistance that leads to outright rejection is evident in the data. For example, the buyer/planners of Allen’s (2005) manufacturer do not use the enterprise system for scheduling, as they need “room to maneuver” (p.38) in their monthly scheduling practices, and prefer to use personal spreadsheets and weekly meetings to convey scheduling information. In another situation, a manufacturing division with a flat structure and informal culture (Hislop et al 2000) was able to outright reject the enterprise system being imposed from the parent company.

In other situations, resistance can lead to a form of loose coupling between the certain practices and the enterprise system. An excellent description of such a situation was described in the grant administration practices of a major university (Wagner & Newell 2004; Scott & Wagner 2003). The principal investigator associated with a grant preferred the flexibility of “commitment accounting” [principal / goal] because the cash outflows of research activity were often unpredictable, and therefore better served by focusing on a “zero balance” (p.314) at the end of the grant period, and avoiding too much specificity within the period [assumptions about cause/effect]. Implementers dismissed such practices as a
“checkbook mentality” and an “outdated mindset” (Scott & Wagner 2003, p.305).

The enterprise system embedded a “time phased budgeting” approach that parsed expenses out in planned increments. This approach was initially rejected outright, and attacked fiercely by powerful faculty. Central administration responded with a number of concessions. In the winter 99–00, leaders representing faculty and departmental administrators lobbied for changes to both the system and the support structures. In response to this pressure, the core group agreed three things. First, they agreed to leave the mainframe legacy system running until additional ERP functionality was created. Second, they would meet the faculty functional requirements by designing ERP-based commitments. Third, the BSC and TSC would be left running at least through the end of next fiscal year (Wagner & Newell 2004, p.317). Thus, initial resistance led to eventual loose coupling.

In other situations, incongruent logics such as the flexibility necessary for engineering activity resulted in resistance, but it is unclear how this resistance was eventually resolved (Newell et al 2003). In another example of unresolved resistance (Dahlbom et al 2000), while the authors show that the “craft production” principles incumbent in the organization are contrary to the standardized automation associated with the enterprise system, they also indicate that in actuality the activities may not be as incongruent as they appear. As is evidenced by a paper based process “The six-week production plan sheet is, of course, the interface to a system that might have been very well run on a computer” (p.95). Regardless of whether the logic is congruent or incongruent, weakly introduced enterprise systems appear to be met largely with resistance. An important point
here is that these responses often lead to adjustments in the relations between the focal community and other adjacent communities that interact with them, which might lead to quite different responses to the implementation of enterprise systems. Therefore, the ultimate fate of the enterprise implementation is determined not only based on the initial reactions by these local practices as noted here, but also through eventual reconfiguration of the relationships among communities over time, as they each figure out how others react to the system implementation and how that might affect their own local practices.

**Congruent Logics, Weak Pressure**

The situation that is least addressed in this sample is that where the institutional logics embedded in the system are congruent with that of practices, yet the system is not introduced forcefully. As indicated above, the government agency where order entry activity was quite congruent, the system was initially introduced with strictly voluntary training (Boudreau & Robey 2005). Implementers were surprised when order entry personnel did not attend training, and they continued to use the paper-based process for as long as they were allowed. When the pressure to use the system was ratcheted up, those personnel found a way to comply. Perhaps the production management activity of the craft manufacturer is similar in that a fairly congruent system was being resisted simply because the institutional pressure that accompanies the system was weak (Dahlbom et al 2000).
In another situation, however, a weakly-introduced system was co-opted and redefined by the managers of a division that the system attempted to standardize (Lee & Myers 2004). Management of the division resisted the implementation directly, but upper management attempted to forcefully introduce the system. The division management proved more powerful in this context (thus the strength of the pressure was weak in comparison), as the managers undermined the system: “From time to time [the division manager] would force a large order through the already congested product delivery schedule to please a big customer. This was because, in his view, Stark had to take care of its large customers. These customers would call up on one day and make demands that their order be put ahead of others. [The division manager] did not want to lose these big customers (and he was prepared to disadvantage smaller customers and disrupt the delivery schedule if needed). Given his power within the company, Dunkins was able to succeed in his demands, thereby completely over-riding (and in effect undermining) the system” (Lee & Myers 2004, p.369).

Eventually upper management changed the scope of the enterprise system implementation to match the demands of the division manager for that division. According to the company's president: “We were quite expansionist and visionary and we came back to a very conservative operational [focus]... So it wasn’t a dramatic change, but it was more a degree of how expansionist we would have been had we wound the dial back a little bit to be more conservative”(Larson & Myers2004, p.370). Thus we find that resistance seems to be likely when the relative strength (pressure associated with the system, net of the resistance) is
weak, independently of whether the logics are congruent or incongruent. Four results of resistance evident in the data are outright rejection, eventual compliance, eventual loose coupling, or a co-opting of the goals of the system.

Discussion

Although there is some indication of support for our conjectures from our analysis of 16 case studies on the implementation of enterprise systems, there are a number of caveats. Our first conjecture about response strategies that involve “acquiescence” or mutual adaptation with the system was consistent with much of the literature that treats compliance primarily as a technical issue that can be resolved by either customizing or configuring the system, or by changing practices to align better with the system (Soh et al 2000; Markus et al 2000; Wei et al 2005). While our analysis supports this conjecture, it is important to note Ciborra’s and Failla’s (2000) description of the extreme amount of effort spent on training and advocating the enterprise system – although congruent, it still took years to take root. In their example, even after taking four years to take root (largely with the help of a complementary application), the level of system adaptation remained inconsistent throughout the organization. With today’s fast-changing industry conditions, waiting more than four years for an enterprise system to become “ready-
to-hand” (Ciborra 2000) across the organization is simply too long. The case suggests that a similar story may be the reality in many implementations.

In our second conjecture, we expected “partial compliance” strategies that lead to the loose coupling of practice with the enterprise system. This second conjecture is an important departure from treatments of “misalignments” of organizational practices with the enterprise system (e.g., Soh & Sia 2004). First, by focusing on institutional logics that guide practices rather than the practices themselves, we are able to distinguish between surmountable, technical barriers to implementation that might be resolved by adaptation, and those that will not. Adaptation responses involve more training, upper management support (greater force), technology tweaking, or process change, and result in progress toward eventual alignment of the practice with the system. If the practices are fundamentally incongruent – which, we argue, would be identified through an analysis of the institutional logics that guide that practice – then this alignment will not occur without changing the practice to something entirely different. Our conjecture appears to be supported by the case data. This result implies that partial compliance allows for existing practices remain unchanged, whereas full compliance can only be reached by changing the nature of these practices.

In one case, however, the response to incongruent institutional logics appeared to involve sincere compliance (Volkoff et al 2005). There are at least two plausible explanations for these findings. One is that our model is wrong, and that we are missing an important confounding variable, or response type. Another explanation
is that the researcher took the compliance with the system at a face value, while there might have been, in fact, “minimal” use of the system which would be consistent with our partial compliance strategy. Perhaps the quality and efficiency problems resulting from the system implementation hint to this explanation, as efficiency and data integration are fundamental objectives of the system. Yet, the outcomes do not appear to be consistent with these objectives.

Our third and fourth conjectures address situations where the enterprise system was introduced without a great deal of pressure, and this form of introduction was invariably met with resistance. This resistance was manifested in a form of overt conflict (e.g., Wagner & Newell 2004) or simply ignoring or avoiding system use (e.g., Boudreau & Robey 2005). An important observation is that resistance seems to be temporary and often leads to something else – eventual acceptance, loose coupling, co-opting, etc. Strategies for dealing with resistance tend to involve gradually increasing the strength of the institutional pressure (Boudreau & Robey 2005; Dahlbom et al 2000). Once the strength is increased, congruent practices approach alignment through mutual adaptation, whereas incongruent practices respond with partial compliance that loosely couples those activities from the system. Of course, the other option is for the group to co-opt the system introduction. Although this strategy is evident in the Lee & Myers (2004) case, it is clear that this possibility is not adequately addressed in the literature.

A key insight from our pluralistic approach is that one needs to focus on “relative power” in attempting to understand the role of power in enterprise systems
implementations. A thorough analysis of our findings points to what may be a flaw in conventional operationalization of the construct of institutional pressure and power. From a pluralistic perspective, it is important to keep in mind that “voluntary” and “involuntary” do not adequately tap into all aspects of institutional pressure. While the coercive forces associated with an involuntary enterprise system implementation may be great, it is possible that other, less explicit forces, such as normative and mimetic pressures (DiMaggio & Powell 1983) are just as powerful in shaping voluntary implementation. While coercive force associated with central management’s top-down initiative is consistent with the conventional notion of power (Introna 1997), the institutional pressure stemming from normative and mimetic pressures point to a very different kind of power. It is more distributed and relative, perhaps more in line with Clegg or Foucault (Introna 1997). The institutional pressure arises as a result of systemic inter-relationships among various local practices, either rationally designed or socially negotiated. Responses to institutional pressure across a network of force relations might be more difficult to detect and should be studied, as these often arise as a result of the reconfiguration of interrelationships among local groups who all struggle to deal with a new enterprise system. In this case, we can detect some indication that the institutional pressure from the coercive top-down management initiative acts more like a first-wave of pressure, whereas the institutional pressures associated with distributed and relative power acts more like a second-wave. Power has long been one of the primary concerns around system implementation (Markus 1983; Introna
1997; Jasperson et al 2003), and the notion of the strength of institutional pressure integrates these political aspects of implementation into our model.

Similarly, actors’ sense-making has been a widely used as an explanation for many IT adaptation outcomes (Lyytinen & Hirschheim 1988; Orlikowski & Gash 1994; Griffith 1999). Institutional logics, as cognitive schema (DiMaggio 1997), capture this notion of sense-making, and the congruence of interpretive schemata is deemed important to technology adaptation (Orlikowski & Gash 1994). Yet institutional analysis goes beyond cognitive schemes of individuals by tying local practices into broader socio-cognitive institutions of professions, organizations and fields. Using an institutional lens, we are able to cover both political and interpretive aspects of information systems implementation in our model, while at the same time tying these notions to the context of both micro and macro behaviors that shape individuals, organizations, and entire societies. Our pluralistic lens allows us to reveal powerful and complex systemic dynamics among interacting socio-cognitive forces, as multiple actors draw on diverse and often conflicting institutions.

**Implications**

We offer two contributions associated with enterprise systems implementation. First, through our institutional analysis we propose a causal explanation of response variations to an enterprise system. This explanation goes beyond the technical / work practice analyses that underlie much of the prevailing ERP literature. This
literature implicitly assumes congruence in the institutional logics underlying both business routines and the IT systems – why would one implement a technology to support a practice with which it is incongruent? We contend that this is an assumption carried over from the tradition of local, customized information technology projects that supported specific and localized tasks of users. But enterprise systems are different. They represent a rationalization, encoding and abstraction of “best practices” that, while being congruent with the logics of certain areas of certain organizations, can be in conflict with others. When there is such conflict, alignment is simply not possible without significantly changing the institutionally enforced practice – essentially making it a different practice altogether. While the principles of efficiency and control may, in fact, reflect the primary goals of managers of an organization – and thus the reason for implementing the enterprise system in the first place - it is important for them to consider that this may not be the case for every group within the organization.

Another contribution is our use of existing, published case studies as a meta-analysis of case data by which we initially validate our theoretical model (Noblit & Hare 1988). Thanks to heightened research interest in ERP systems we were able to access a rich variety of data sets in published, interpretive case studies. While this validation was not expected to be an irrefutable test of our model, it shows that our model has some empirical support. It also show that some level of external and internal validity for theories can be obtained by mining case data in cases where extensive statistical analyses are not possible due to lack of representative samples or where cost of access is an issue.
The analysis also highlights some areas where we can still tighten up our operationalization. Our chosen method is not without its drawbacks. First, we face the problem of the double (or triple?) hermeneutic (Giddens 1984). The researchers who created the case studies are interpreting the interpretations evident in individual accounts. We then interpreted these interpretations again. In many cases significant amount of inference was required to make sense of an article for our purposes. In certain cases this resulted in difficulties in correctly accounting for behaviors as our interpretations differed from the researcher's interpretations (e.g., Volkoff et al. 2005). In addition, case researchers asked specific questions that were different from ours. Overall, through this method we add distance between our interpretive activity and the phenomena of interest. Nevertheless, we feel that these limitations were more than balanced by the access to a variety of cases across multiple practices, industries, and geographic locations. This provides a level of external validity that would be virtually impossible in a traditional empirical multi-case analysis.

The practical contribution of this study is recognition of the diversity of guiding principles and assumptions across routinized practices in an organization. Too often practitioners approach enterprise system-related issues from the rationalistic perspectives of efficiency, standardization, and integration and an implied assumption of a universally uniform outlook. However, organizations enact a rich variety of practices that are not compatible with these espoused driving principles. Furthermore, there is an assumption that the data within an enterprise system faithfully reflects the practices that it is supposed to support. Our recognition of the
partial-compliance that loosely couples the enterprise system from the practices shows that this assumption is often unfounded.

**Conclusion**

Institutional theory has been advocated as a meaningful approach for information systems research (Orlikowski & Barley 2001), and has been promoted to be particularly well-suited to the study of enterprise systems (Gosain 2004). In this paper we make steps in this direction by proposing an institutional model that marries institutional logics and ERP systems together in a way that predicts and explains organizational responses to ERP implementations through a pluralistic lens. While the institutions we identify are concerned with micro-practices, it is these micro-practices that both draw from and contribute to the major institutions surrounding the system use (Powell & DiMaggio 1991).

Our framework hinges on the device of an “institutional logic,” which is consistent with Bourdieu’s (1977) notion of “habitus.” In using this lens, we attempt to characterize the primary cognitive enabler and guide of human practices. The habitus is the sum of the dispositions of individuals, born of experience, that drive the way these individuals approach their practices. Individuals attend to formal rules and norms, and in this case, ERP systems, from the habitus. In adopting the notion of an institutional logic, we are, in effect, approximating a form of root-cause analysis of individual and group responses to enterprise systems. Congruence with
the institutional logic becomes a key determinant in a given user’s attitude towards the system.

We initially validated our model using 16 published, interpretive case studies. This novel approach (Noblit & Hare 1988) enabled us to gain insight into a variety of geographically distributed contexts across industries. We found some evidence to support our model while we also found inconsistencies and avenues to improve our operationalization and analysis. This methodology has some limitations, however. In particular, the interpreted data had to be re-interpreted for our purposes. Thus we ran into a situation where only the descriptions that fit the research questions of other projects could be included in ours. For example, any indication of resistance necessarily seemed to imply weak pressure, which is a circular argument. Future research will involve collecting original data to further test and refine the model. By measuring strength of pressure directly, for example, we should be able to avoid tautological pitfalls, while at the same time embark on a more finely-grained analysis of the role of power and sense-making in enterprise system implementations.
Appendix B - Institutional Pluralism and Loose Coupling: The Case of NASA’s Enterprise Information System *

Abstract

Research on the implementation of enterprise information systems stresses that initial misalignments between the system and existing activity necessitate a mutual adaptation process that eventually results in alignment, or tight coupling, between the technology and organizational activity. This alignment is argued to be essential for the improved integration and control that is widely associated with enterprise systems. However, many of these misalignments may in fact reflect broader, institutional conflicts, and conflicting institutions can only co-exist within an organization through loose coupling. In an institutional analysis of NASA’s ERP implementation, we examine the heterogeneity of institutional logics that influence the enterprise system adaptation process. We identify four broad forms of loose coupling in this context: temporal, structural, material, and interpretive. Further, while we find loose coupling to be in evidence, it is not uniformly evident across any given group as individuals draw upon a variety of institutional logics to guide their actions and maintain their unique identities. By focusing on the heterogeneity of the institutional logics that guide activities within an organization, our findings provide an explanation for varying appropriations of enterprise systems in organizational contexts by linking ostensibly idiosyncratic system appropriation with the stability and persistence of society’s broader institutions.

Institutional Pluralism and Loose Coupling: The Case of NASA’s Enterprise Information System

“A loosely coupled system is not a flawed system. It is a social and cognitive solution to constant environmental change, to the impossibility of knowing another mind, and to limited information processing capabilities. Loose coupling is to social systems as compartmentalization is to individuals, a means to achieve cognitive economy and a little peace.” - Karl Weick, 2001, p.44

Introduction

Organizations implement large-scale, standardized enterprise information systems across a wide array of local, idiosyncratic practices. In order for such systems to be successful, they must be adapted into organizational environments, and these adaptations involve customization of the system or modifications to organizational practices (Davenport 1998; Markus et al 2000; Sia & Soh 2007). In order for the system to become fully utilized, organizational practices need to be aligned, or tightly coupled, with the enterprise system. This tight coupling between the system and organizational activity is seen to be a necessary condition for realization of the vision of seamless integration and tight control that is typically associated with enterprise systems (Ciborra 2000; El Amrani et al 2006).

While research on enterprise systems addresses alignment and organizational responses to enterprise systems at length, organizational reaction to enterprise systems are often treated as homogeneous and monolithic - largely simplifying the diverse and complex social reality of modern organizations (Boudreau & Robey 2005, Lamb & Kling
Furthermore, given that enterprise systems not only prescribe practices associated with system use, but also embody assumptions about practices outside of the system, compliance with process prescriptions is essential for system success. Since users participate in a wide variety of practices outside of system use (Lamb & Kling 2003), and these practices are likely to be heterogeneous (Boudreau & Robey 2005), we look to understand the implications of this different set of assumptions associated with organizational reactions to enterprise system implementations.

To address this issue, we adopt an institutional perspective to study enterprise system alignment (Gosain 2004; Sia & Soh 2007). Institutional theory offers a theoretical lens for analyzing goals, values, and prescriptions that underlie and legitimate behaviors of groups and individuals. Although institutional theory typically treats organizations as singular actors, an emerging view that acknowledges “institutionally plural” organizational contexts treats a given organization as a nexus of nested institutions, some of which are compatible while others conflict with each other (Kraatz & Block 2008). Each of these institutions can be described in terms of the “institutional logic” of its structures (Friedland & Alford 1991; Thornton & Ocasio 2008), which shape and are shaped by the actions and beliefs of individuals in organizations, and tie back these actions and beliefs to society’s broader institutions.

From an institutional perspective, implementation of an enterprise system in an organization can become disruptive because the system may embody an institutional logic that is different and challenges existing practices that are grounded in a different logic (Gosain 2004; Sia & Soh 2007). Institutional theory informs us that responses to incongruent institutional logics often involve the “loose coupling” (Orton & Weick 1990)
of existing practice with the demands of the new institution (Meyer & Rowan 1977; Oliver 1991). While other researchers have observed loose coupling between enterprise systems and organizational groups (e.g., Pollock & Cornford 2004; Wagner & Newell 2004), prior studies treated members of specific groups as uniform in their responses to the enterprise system.

We look into an agency-wide implementation of an Enterprise Resource Planning (ERP) system at National Aeronautics and Space Administration (NASA) to gain insight into the responses of users as heterogeneous social actors where heterogeneous, and often conflicting, institutional logics of their everyday actions appear to be incongruent with the institutional logic of the system. In this case study, we examine: (a) the heterogeneous nature of the users’ response to the enterprise systems; and (b) the mechanisms that reconcile the logic of ERP systems and various institutional logics that enable and constrain everyday practices of users. In the remainder of this paper we will briefly identify how the notion of alignment is treated in information systems literature, articulate the dimensions of our primary construct, “institutional logics,” and present our findings from the case study.

**Literature Review**

**Alignment and Enterprise Systems**

Information technologies rarely fit perfectly with organizational practice at first. Organizations therefore typically engage in an adaptation process where practices and technology align together over time (Leonard-Barton 1988). Mutual adaptation between practice and technology can be a gradual process (Orlikowski 1996), or it can occur in shorter-term, punctuated windows of opportunity (Tyre & Orlikowski 1994). This notion
of alignment has been adopted by researchers who specifically study enterprise-wide information systems, as well. As enterprise systems are based on standardized, packaged software that is meant to cover a wide range of organizations with generic, adaptable procedures (aka “best practices,” see Wagner et al 2006), initial “gaps” or “differences” between the technology and existing practice is often quite dramatic (Davenport 1988, Sia & Soh 2007).

There are a number of responses available to organizational actors to address these misalignments in an enterprise system context. For example, an organization can change its practices to fit those implied by the software (Davenport 1998). Alternatively, the software can be configured (Markus et al 2000) or customized significantly (Sia & Soh 2007) to support existing organizational practices. Within this customization and adaptation space there remains a wide opportunity for user “work-arounds” or improvisations in many forms (Ciborra 2000; Boudreau & Robey 2005; Wagner & Newell 2004). Of course, one way to respond to misalignments is simply to avoid or resist using the system (Lapointe & Rivard 2005).

However, the notion of mutual adaptation is not unproblematic. Cycles of mutual adaptation often uncover additional misalignments (Majchrzak et al 2000) and different individuals perceive and interpret misalignments differently (Susman et al 2003, p. 143). Further, the notion of alignment involves aligning more than just a single technology with a single practice, but also across ostensive, performative, and material aspects of practice (Volkoff et al 2007) and across multiple socio-technical levels within organizations and their environments (Lyytinen & Newmann 2006).
In enterprise system research in particular, this notion of alignment is problematic because such systems are implemented across diverse communities in multiple phases with multiple modules over time in waves. At no point is an enterprise system implementation fully completed and perspectives on success at any given moment can vary dramatically between stakeholders at various times in the implementation (Markus et al 2000). Beyond this, misalignments tend to cascade over time in the implementation process (Wei et al 2005). Yet, the image of mutual adaptation remains the prevailing frame through which enterprise system implementation is viewed (Sia & Soh 2007). In order to realize the promise of enterprise integration, that is, tightly coupling organizational groups and processes (Barki & Pinsonneault 2005), and to control this activity enterprise systems must be aligned, or tightly coupled, with organizational activity (El Amrani et al 2006).

Recently, causal theorizing about enterprise system implementation indicates that conflicting institutions in the form of an enterprise system and existing organizational practice may be at the root of many misalignments, and may pose challenges to eventual alignment of practice (Gosain 2004; Sia & Soh 2007). We will draw on this view of institutional inconsistencies to ground our view of enterprise system appropriation, and further extend the lens of mutual adaptation by explicitly incorporating the heterogeneity of the contexts of enterprise system implementations.

**Institutional Pluralism and Loose Coupling**

While the bulk of institutional literature focuses on macro-level phenomena concerning industries, sectors, and fields - with organizations as the smallest level of institutional actor (e.g., DiMaggio & Powell 1983) - Powell and DiMaggio (1991)
caution institutional researchers that any macro-level phenomena can find their roots in micro-level human action. Drawing upon Bourdieu’s (1977) notion of *habitus*, Powell and DiMaggio describe internalized rules that are chronically reproduced by individuals through everyday action, yet generative in nature, as the foundation for conceptualizing institutions.

We view an institution simply as “an organized, established, procedure” (Jepperson 1991, p.143). The term “organized” implies structure, and “established” implies historicity and persistence of the procedure over time. This procedure, when reproduced consistently, describes a specific social order or pattern that guides the actions of individuals through their rule-like qualities, and from which individuals establish their identities and draw upon to maintain identities (Jepperson 1991). Examples of the variety of institutions at multiple levels include the handshake, marriage, the academic discipline, or wage labor. Each of these examples can be considered institutions within the appropriate context (Jepperson 1991). Therefore, institutions are nested within each other – from individual micro-practice to supraorganizational patterns of activity – and these institutions often overlap with each other, forming complementary or contradictory relationship (Friedland & Alford 1991).

Although individuals are constantly influenced by a multitude of institutions, they are not passive recipients of institutional forces; instead, they actively respond to the forces associated with institutions in a variety of ways (Oliver 1991; Goodstein 1994), producing and reproducing a variety of institutions (Giddens 1984). In the durée of ongoing activities, individuals draw upon the logic of a given institution as they take specific actions. An “institutional logic” can be described as “a set of material practices
and symbolic constructions – which constitutes its organizing principles and which is available to organizations and individuals to elaborate… These institutional logics are symbolically grounded, organizationally structured, politically defended, and technically and materially constrained” (Friedland & Alford 1991, p.248-249).

It is important to stress that these logics can be fiercely defended, as institutional logics are fundamental components of individual identity (Friedland & Alford 1991; Thornton & Ocasio 2008). While Friedland & Alford (1991) focus on institutional logics of broad, societal level institutions (i.e., capitalism, the state, democracy, family, religion, science), the same construct can be applied to the taken for granted, micro-level logics that guide individual actions (Thornton & Ocasio 2008). Individuals can be expected to cling to the institutional logics that have guided their actions and given them meaning in the past, and they will not easily move to new, incongruent, institutional logics (DiMaggio 1997). When presented with the force of a new, incongruent, institution (for example, prescriptions from upper management), individual actors experience dissonance that makes exchange between groups difficult (Bacharach et al 1997). To address this dissonance, local actors have a number of potential strategies in responding to the forces associated with new institutional logics, including acquiescence, defiance, avoidance, and compromise (Oliver 1991). If the new logic is introduced with a great deal of force (such as the mandatory use of an enterprise system), local actors are likely to respond with tactics that maintain loose coupling with the new institutional logic – such as compromise and avoidance (Goodstein 1994).

In order to further explore the clash of incongruent logics, and thus operationalize the concept, we draw the following four key attributes of an institutional logic from our
review of the literature (see Table 1). First, institutional logics act as organizing principles that guide activities, and thus embody the goals and values of the institution (Friedland & Alford 1991; Thornton & Ocasio 2008; Townley 1997). Second, institutional logics are founded on assumptions associated with specific causal means-end relationships (Friedland & Alford 1991; Bacharach et al 1997). Third, institutional logics are drawn upon to form individual identities (Thornton & Ocasio 2008; Friedland & Alford 1991; Dimaggio 1997; Jepperson 1991; Townley 1997). Fourth, institutions are more and less salient to specific domains and their practices (Powell & DiMaggio 1991; Jepperson 1991).

Table 1: Dimensions of Institutional Logics

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Definition</th>
<th>Source</th>
</tr>
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<tbody>
<tr>
<td>Principles</td>
<td>Goals and values of the institution</td>
<td>Friedland &amp; Alford 1991; Townley 1997</td>
</tr>
<tr>
<td>Assumptions</td>
<td>Understanding of causal means-end relations</td>
<td>Bacharach et al 1997; Friedland &amp; Alford 1991</td>
</tr>
<tr>
<td>Identity</td>
<td>Individual or group identities implied by practices guided by the institution</td>
<td>DiMaggio 1997; Friedland &amp; Alford 1991; Townley 1997; Thornton &amp; Ocasio 2008</td>
</tr>
<tr>
<td>Domain</td>
<td>Context or specific practices associated with the institution</td>
<td>Powell &amp; DiMaggio 1991; Jepperson 1991</td>
</tr>
</tbody>
</table>

We view a contemporary organization as a nexus of intersecting and often conflicting institutions (Kraatz & Block 2008). Within such an organization, individual actors reflexively draw upon a repertoire of established institutions to guide their daily practices, and different actors draw upon different institutional logics to guide their practices. Contemporary organizations manage the incongruence among this multitude of institutional logics through loose coupling. An organization focused exclusively on efficiency concerns, for example, might tightly couple organizational activities with
management structures across the organization. However, contemporary organizations that combine efficiency concerns with often conflicting concerns such as innovation, reliability, and agility, or are dependent on professional or political resources, tend to loosely couple organizational activities from management structures to a greater or lesser extent. Thus, contemporary organizations are subject to “institutional pluralism,” as they are influenced by multiple institutions simultaneously (Kraatz & Block 2008). Such pluralistic organizations maintain the conflicting institutions they are subject to through mechanisms that enable loose coupling such as informal coordination, the avoidance of detailed inspection, different forms of control (for example, those not based on outcomes), and the performance of activities “beyond the purview of managers” (Meyer & Rowan 1977, p.57-58).

Through loose coupling, then, the messy reality of organizational activity need not interfere with the “assumption that formal structures are really working...[loose coupling] enables organizations to maintain standardized, legitimating, formal structures while their activities vary in response to practical considerations” (Meyer & Rowan 1977, p.58). Loose coupling refers to patterns of action that are distinct, or separate from each other, yet are still responsive to each other in some fashion (Orton & Weick 1990). Loose coupling is a dialectic concept intended to offer an alternative to both tightly coupled and decoupled system concepts. Tightly coupled systems are highly integrated and responsive to each other, while decoupled systems are completely separate and unresponsive (Orton & Weick 1990). Thus, it is through loose coupling that incongruent heterogeneous institutions can coexist within an organization.
The implementation of enterprise systems in contemporary organizations, therefore, should be understood in the backdrop of this institutional pluralism and loose coupling of heterogeneous institutional logics. In the literature, enterprise systems are often characterized as carriers of a dominant management logic (Gosain 2004). We expect that heterogeneous actors in organizations respond in diverse ways to the force of a newly imposed institutional force based on the institutional logics that govern their daily practices.

Information systems research that takes an institutional perspective often treats organizations as single actors (King et al 1994; Ang & Cummings 1997; Damsgaard & Lyytinen 2001; Liang et al 2007; Currie & Guah 2007), which is consistent with the larger body of institutional theory (in the tradition of DiMaggio & Powell 1983). In such research, the focus is often on particular institutional logics that dominate an organization and may change over time as new conflicting institutional logics become dominant (Gosain 2004; Currie & Guah 2007). However, through a lens of institutional pluralism, we examine how heterogeneous actors in organizations respond in diverse ways to the force of a newly imposed institution, based on the institutional logics that govern their daily practices.

We look to NASA as an organization awash in conflicting institutional logics, post ERP adoption, to gain theoretical insight into the way that organizational actors react to the institutional logic of the ERP system when this logic is incongruent with that of existing practice. Specifically, we look to examine how local practices that are guided by different institutional logics which are incongruent with that of an ERP system respond to the implementation of that system by loosely coupling their everyday activity from the
representation of that activity in the system. Thus we look to understand how this loose coupling is maintained, whether this loose coupling is uniform within groups, and to identify any institutional regularities that are evident in explaining this loose coupling.

Case Study

Research Method

We conducted a nine month field study of NASA’s agency-wide implementation of an ERP system immediately after the agency went live in 2003. The objective of the study was to understand individual responses to an enterprise system implementation, in what we would argue to be a highly institutionalized, yet pluralistic organization (Meyer & Rowan 1977; Kraatz & Block 2008), and therefore we would anticipate a high degree of misalignment between practices and the enterprise system across the organization. As revelation rather than generalization is the goal for this research, a single case was deemed adequate (Yin 2003). A total of 68 interviews were conducted throughout Agency Headquarters in Washington D.C. and at two centers, NASA Glenn Research Center in Cleveland, Ohio, and Marshall Space Flight Center, in Huntsville, Alabama. Interviewees can be grouped as follows: 22 finance and administration personnel and manager; 15 ERP implementation team leaders and members; 23 center managers, research managers, and researchers; and 8 project managers.

Data were collected using open-ended interviews (Yin 2003) typically one hour in duration. Because the research deals primarily with personal perceptions of individuals about the enterprise system implementation and their tactics for reacting to this implementation, strictly structured interviewing did not apply. Rather, we looked to understand specific events and their contexts before embarking on any given line of
questioning. Therefore, interviewees were treated more as “informants” than “respondents” throughout the interviewing process (Yin 2003; p.90). The interviews were not entirely unstructured, as informants were asked to bring examples of positive and negative experiences associated with the enterprise system implementation with them to the interview. During the interview, we followed a general process of asking personal information about the individual, her position, and the activities that she engages in on a regular basis. Then two broad areas of the enterprise system implementation were specifically addressed through open-ended questioning, namely, the Integrated Financial Management (IFM), and the Full Cost Program, which is activity-based costing enabled by ERP.

A research database and central repository were created for the research project (Yin 2003). The research repository included every transcribed interview, as well as all digital documentation and a number of internal NASA reports about the implementation, as well as audit reports concerning the enterprise system implementation from the U.S. General Accounting Office (GAO), the NASA Advisory Council (NAC), and the Inspector General (IG). In order to triangulate our interpretation of the events (Yin 2003), a full case write-up was collaboratively created by the authors and submitted to NASA management. They agreed that our depiction of events was accurate.

The interview data were analyzed following Strauss & Corbin’s (1988) model of grounded theory development, which involved three rounds of coding with continuous iteration between the data and our theoretical interests (Eisenhardt 1989). This iteration helped amplify our theoretical sensitivity (Strauss & Corbin 1988) through the extraction of themes such as ‘misalignments’, ‘institutional logics,’ ‘loose coupling,’ and
‘reconciliation mechanisms’ (i.e. the ways in which loose coupling was maintained). The first round involved note-taking and open coding (Strauss & Corbin 1988), through which we became immersed in the data and began to explore for recurring themes, where we identified misalignments between practices and the system, as well as associated individual responses. The second round involved selective coding (Strauss & Corbin 1988), where we identified the espoused institutional logics that guided specific practices. A third iteration through the data was intended to identify the prevailing institutional logic associated with the enterprise system (Gosain 2004) in the eyes of NASA employees, as well as through the official documentation. To organize and display the data we used ‘conceptually ordered descriptive matrices’ (Miles and Huberman, 1994), which are used to order qualitative data for subsequent clustering and partitioning. We operationalized these matrices through a Microsoft Access database that contained records with detailed information about each informant, which were then related to records containing that informant’s descriptions of misalignments, responses to the ERP system, and a variety of codes for the type of misalignment and type of response. Subsequent axial coding outputted to an Excel spreadsheet, combined with notes taken from non-interview data, supports our analysis.

**NASA’s Structure**

NASA was established in 1958 with the passage of National Aeronautics and Space Act. From the beginning, separate centers were established in order to meet unique challenges of fulfilling the mission of the Agency. These centers were established for specific technical or political reasons at the time of founding the agency. For example, Glenn Research Center in Cleveland inherited the Aircraft Engine Research Laboratory.
of the National Advisory Committee for Aeronautics, which was founded during the World War II. The center naturally focuses on aeronautics research. On the other hand, Johnson Space Center in Houston was established by Kennedy administration in part to win Southern voters. Overtime, each center has become a well-established fixture in its local community, and funding for centers is vigorously defended by local and federal legislators. Through the years, each center has established its own unique competencies, culture, structure, and technical infrastructures. This has resulted in “stove-piped” information systems, organizational processes, accounting standards, and cultures at each center and for the wide array of functional groups within each center. Each functional area built systems in order to meet their idiosyncratic needs, without regard to compatibility with other locations. Also, similar capabilities and knowledge resources were established in different centers, resulting in further redundancy.

Figure 1: Illustration of NASA’s Structure

Beyond the ten centers, NASA had seven “Strategic Enterprises” that cut across individual centers (at the time of data collection) that directly support NASA’s space and
science missions and over fourteen functional offices that maintain the institution and cover a variety of management and advisory roles including financial, human resource, procurement, engineering, safety, and information technology. The seven enterprises – Aeronautics (Code R), Biological and Physical Research (Code U), Earth Science (Code Y), Education (Code N), Exploration Systems (Code T), Space Flight (Code M), and Space Science (Code S) – are funded by NASA headquarters and use their resources across multiple centers. Congress authorize NASA budget based on the programs proposed by these enterprises. Figure 1 presents a stylized description of NASA’s organizational structure.

The structure of individual center mirrors the NASA’s management structure. Each center is organized with program and project offices in addition to performing organizations and “institutional functions.” Performing organizations provide engineering, scientific, and technical capabilities within centers. Institutional functions provide basic business support such as accounting, human resource, facility management, and information technology. Examples of performing organizations at Glenn (the Center in Cleveland, Ohio) include the Space Flight, Safety and Mission Assurance, and Research and Technology directorates, among others. Within each of these broad organizations are specialized “offices,” for example, within the Space Flight Directorate (which focuses on propulsion technology for space vehicles) there is the Advanced Flight Office, the Launch Systems Office, etc. These offices often have subgroups that specialize further.

Program and project managers at local centers receive their funding from the strategic enterprises in the headquarters to hire engineers and scientists from performing
organizations or contract out parts of works to non-NASA organizations such as universities or private firms in order to fulfill the missions of the enterprise. Often program and project offices span over multiple centers, drawing in scientists and engineers from multiple centers and coordinating their works. As the financial health of the Center depends largely on employment of the performing organizations and full utilization of institutional functions, there are often implicit competitions to promote the competencies and expertise among local centers. On top of this complex structure, NASA has always encouraged competition among centers in order to produce the best possible outcomes. Centers compete for the program funds with independent proposals.

This broad view of NASA’s structure points toward a set of nested organizations with a variety of sometimes conflicting goals. Table 2 below describes instances of these nested organizations, with example goals at that level of analysis. As an Agency, while the ostensible goal of NASA involves space exploration and science, to support this goal the center must also engage in administrative activity, advocacy for funding, etc. Similarly, while the overall goal of Glenn as a Center involves maintaining the Center’s health, this could involve efficient and effective operations as well as the maintenance and development of certain competencies that improve the position of Glenn relative to other centers. This relative positioning and competition between Centers may be in-line with certain aspects of the overall mission of NASA, and it may be in conflict with certain other aspects of NASA’s mission. That is, this inter-center competition led to redundant capabilities which sometimes conflict with efficiency goals of the agency, but may be in-line with the goals relating to scientific progress.
Table 2: Nested Organizations within NASA

<table>
<thead>
<tr>
<th>Organization Type</th>
<th>Unit</th>
<th>Instance</th>
<th>Example Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Agency</td>
<td>Government Agency</td>
<td>NASA</td>
<td>Space Science &amp; Exploration</td>
</tr>
<tr>
<td>Center</td>
<td>Field Center</td>
<td>Glenn Research Center in Cleveland, Ohio</td>
<td>Health of Overall Center</td>
</tr>
<tr>
<td>Performing Organization</td>
<td>Office within Directorate within Center</td>
<td>Advanced Flight Office in Space Flight Directorate</td>
<td>Continued Science &amp; Engineering Activity</td>
</tr>
<tr>
<td>Strategic Enterprises</td>
<td>Program or Project within Enterprise</td>
<td>Lunar Rover Program in Exploration Systems Enterprise</td>
<td>Tracking Mission Progress &amp; Budget</td>
</tr>
<tr>
<td>Institutional Support Functions</td>
<td>Functional Department within Center</td>
<td>Glenn Accounts Payable Department</td>
<td>Efficient Bill Pay</td>
</tr>
</tbody>
</table>

From this brief analysis, we see NASA as an organization within the wider organization of the U.S. Federal Government that is comprised of multiple, nested organizations, whose goals and activities can be consistent with each other, but also can be in conflict. Further, NASA has recently been subject to pressure and scrutiny from other branches of the U.S. government. The tragedies associated with the Columbia and Challenger space shuttle crashes have led to probes into NASA’s organizational practices. Resulting from these investigations, a lack of communication and collaboration has been recognized as an organizational problem within NASA\(^7\). For example, the findings in the Columbia Accident Investigation Board (CAIB) report\(^8\) reinforced the necessity of inter-center communication and collaboration. This has led to the “One NASA” initiative where the NASA is looking to break down the silos and collaborate and communicate across all centers more effectively.

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\(^7\) For academic analysis of these tragedies and related insight into the NASA organization, see Starbuck & Farjoun 2005 (see Garud & Dunbar essay in this text for a characterization of two competing institutional logics they describe as “operations” and “development”)

\(^8\) As a U.S. government agency, a great deal of documentation on NASA is available in the public domain. This report is available at: [http://www.nasa.gov/columbia/home/CAIB_Vol1.html](http://www.nasa.gov/columbia/home/CAIB_Vol1.html)
The Executive branch of the U.S. Government has also been focusing on greater accountability and efficiency from its Agencies with initiatives such as Clinton-Gore’s “Reinventing Government” and Bush’s “Presidential Management Agenda.” In addition, there have been a series of regulatory and statutory requirements that NASA needs to meet in financial management. These include the Chief Financial Officer’s Act of 1990, the Federal Financial Management Improvement Act of 1996, and OMB Circular A-127 that requires a single integrated system for financial management. The mounting pressure erupted when NASA failed to account for more than $5 billions of budget overrun on the International Space Station project. Such inability to account for its cost due to its complex internal accounting structures hurt NASA’s reputation in other areas of the U.S. Federal government.

Recognizing these growing pressures, NASA unsuccessfully attempted to build an integrated accounting and financial systems twice in 1989 and 1995. In 2000, NASA re-established the Integrated Financial Management Program (IFMP) and chose to implement SAP throughout the agency. Marshall Space Center was selected as the lead center where most technical implementation teams are based, and Glenn Research Center was chosen as the first phase site. The first wave implementation of SAP Core Financial module at Glenn went live in October 2002. The rest of the agency went live with financial core in fall of 2003. Although the system officially went live in October 2002 at Glenn, there were continuing training, minor upgrades and fixes throughout the duration of the data collection.

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9 Subsequently, NASA implemented budget formulation, updated version of financial core, project management and asset management modules. Currently the project is combined with the e-Government initiatives.
Institutional Logics within NASA

Through interviews with center managers, research managers, project managers, and researchers interviewed, we uncovered four distinct institutional logics that guided practices associated with the enterprise system (see Table 3). Our presentation of the data will be organized according to these logics.

Table 3: Selected NASA Institutional Logics and Practices

<table>
<thead>
<tr>
<th>Locus</th>
<th>Logic</th>
<th>Related Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise System</td>
<td>Logic of Managerial Rationalism</td>
<td>-</td>
</tr>
<tr>
<td>Project Managers</td>
<td>Logic of Project Management Professionalism</td>
<td>Project tracking</td>
</tr>
<tr>
<td>Researchers</td>
<td>Logic of the Scientific Professionalism</td>
<td>Researcher procurement</td>
</tr>
<tr>
<td>Center Administrators</td>
<td>Logic of Organizational Persistence</td>
<td>Budget management</td>
</tr>
<tr>
<td>Research Management</td>
<td>Logic of Organizational Persistence</td>
<td>Time reporting</td>
</tr>
</tbody>
</table>

This is not intended to be an exhaustive list of the multiple logics associated with NASA’s ERP implementation, but rather a set of examples intended to offer insight of how different institutional logics that are dominant in local groups come to collide with the institutional logic that is often identified with the enterprise system. First we will describe the institutional logic identified with the enterprise system, as NASA employees saw it. We then will articulate each of the three other institutional logics that dominate different local groups and draw out a practice where there was evidence that each of these logics came in conflict with that of the enterprise system, and resulted in some form of loose coupling. We will then give an example of individuals in those same groups who appear to be guided by logics congruent with that of the enterprise system and exhibit
practices that are faithful to the logic associated with the system. These exceptions are included in the data presentation as evidence of diverse responses within these local groups.

**ERP & the Logic of Managerial Rationalism**

Throughout the interviews and document review, the institutional logic of the enterprise system is uniformly characterized throughout the organization. NASA has a long history of exceeding the budget allocated for its programs. For example, the U.S. General Accounting Office (GAO) who audits NASA annually indicates that NASA cannot accurately report expenditures associated with its programs, there is disagreement on opening balances each year, and a number of other reporting issues (GAO 2005). Reports about NASA’s ability to account for expenditures are virtually the same each year: “NASA remains unable to provide reliable and accurate detailed support for the amounts obligated in all years against the spending limits. As such, GAO is unable to verify the amounts charged against the [program] spending limits…” (GAO 2005 p.18). In each of the GAO’s reports, the IFMP that hinges upon implementation of Agency-wide ERP is seen as the tool by which NASA will one day begin reporting accurately. Below, we will briefly address each of the four attributes of the institutional logic of the enterprise system.
Our data shows that accountability to external control in the U.S. Government is goal of the enterprise system. This control takes the form of adherence to approved program budgets. A wide variety of informants articulated the role of the ERP system in bringing accountability to the organization:

Congress wants answers; we need to be able to give them answers...What [the ERP system] says is it’s the mechanism of tracking those costs and rolling them up from the bottom to the top (Senior Research Engineer, interview transcript 2-11).

The logic of managerial rationalism is associated with a set of assumptions about the technology and standardization. For example, according to a Glenn manager, accountability that is necessary for NASA to gain credibility can be attained through
standardization and ERP is an instrumental tool to achieve it: “[The ERP system] is supposed to put the decision making in the hands of the programs… put all of NASA in a business process, the same business process” (Glenn Resource Analyst, interview transcript 2-12). Table 4 also illustrates this through NASA’s official press release emphasizing accountability.

One effect of this standardization is that identities according to the system remain largely undifferentiated – the ERP system “does tend to compartmentalize people” (Glenn Center Executive, interview transcript 1-8). Through standardization, the logic of the enterprise system rationalizes NASA’s organizational activity through cost and budgetary requirements of programs.

Finally, the domain of the enterprise system involves the financial practices of the organization. As the key enabler of an accountability-driven management initiative, financial criteria were expected to guide action and take a driving role in NASA policy. Many of the informants attested to the financial emphasis of the system, and even researchers who did not adopt the institutional logic to guide their procurement activity articulated it soundly: “When applied to the breadth and depth of the organization it could help us understand how we’re spending our money, how we’re allocating our resources and then make good business decisions based on that.” (Researcher B, interview transcript 2-11)

Taken together, we describe the institutional logic associated with the ERP system as the “logic of managerial rationalism,” which leverages a common institutional term to capture the external coercive forces that the various branches of the U.S. Government wish to exert upon NASA - to manage NASA’s activity based largely on the highly
visible and standardized financial data that can only be available if the financially-oriented practices are consistent with the prescriptions of the system. Below, we identify three additional institutional logics that guide the practices of different actors at NASA which can be in conflict with this logic of managerial rationalism.

Project Tracking & the Logic of Project Management Professionalism

Project managers often identify themselves with managing variance. As they attempt to manage and track scientific and engineering projects, budgets exist, but the timing of activity, magnitude of expenditures, and project outcomes all vary – and project managers pride themselves on accurately gauging and communicating this variance. The logic of control associated with the ERP system, however, assumes fixed budgets, fixed calendar-based time frames, and tracks expenses when recognized rather than accrued. Research and engineering progress and accompanying expenses are difficult to predict and rife with variance. Therefore, project management activity is often loosely coupled to the ERP system. One project manager was quite adamant about the inappropriateness of the ERP system for her job due to project variance:

That means absolutely nothing to a project manager like myself who is tracking plans versus actuals. What are my variances? Who blew my budget? Who’s overrunning? Who’s under running? To me a ledger was not going to help me very much with that. (Project Manager A, transcript 2-9)

Many project managers resisted using the system initially. The implementation team considered the ERP system as simply a “new” way of managing budgets, and generally thought that project manager adoption was simply a case of learning the tool, and therefore unplugged the legacy system and forced project managers to work within
ERP. However, project managers simply could not get the reporting they needed out of ERP, so the implementation team had to customize a reporting tool to accommodate project manager requests.

Table 5: Logic of Project Management Professionalism

<table>
<thead>
<tr>
<th>Institutional Logic Dimension</th>
<th>Characterization of the Logic of Variance</th>
<th>Representative Quotation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Principles</strong></td>
<td>Deliver project results.</td>
<td>At the end of whatever I do, I have to deliver a working product. (Project Manager B, 3-3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The goal of projects is to accomplish what they propose to be able to do when they sold the project. (Project Manager C, interview transcript 2-12)</td>
</tr>
<tr>
<td><strong>Assumptions</strong></td>
<td>Project results through tracking and communicating project progress.</td>
<td>I’m a good project manager because I reported to my management exactly where I was; I appropriately went through all the phases and requested more money; and I’m okay...I don’t have to be that good at almost anything as long as at the end it works. I don’t have to be cost-effective... (Project Manager B, interview transcript 3-3)</td>
</tr>
<tr>
<td><strong>Identity</strong></td>
<td>Track and communicate unpredictable activity</td>
<td>I manage risk. I evaluate the possibilities of doing things several different ways, and choose a path that is not necessarily the cheapest. (Project Manager B, 3-3)</td>
</tr>
<tr>
<td><strong>Domain</strong></td>
<td>Financial as well as other domains associated with projects</td>
<td>We have a list of tasks and discreet milestones and products for each one of those; and we have a schedule, so and we can look at it, did we deliver that product and did it come in ahead of schedule or did it come in behind schedule...whether the technical work is being done and then there’s the financial metric... (Project Manager D, interview transcript 2-25)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The things a project manager would need is to tie schedule performance and cost performance together... you not only need to tie cost, but you need to tie workforce together. (Project Manager E, interview transcript 2-26)</td>
</tr>
</tbody>
</table>

Despite this accommodation, many project managers indicate that they manage projects outside of the system – on “shadow systems” – only to periodically reconcile the data in these outside systems with ERP. This activity is widely prevalent across the project manager community, and the project managers that report this activity often explicitly call out variance as important to guiding their activity:
We’re still, … using offline systems, planning spreadsheets... we use the business warehouse [reporting tool for ERP] as a data source... extract the data off and still put it in our front end that we give the project managers in their monthly status report. We build a phasing plan at the project level offline from the center-level system. Okay. We extract the actuals off the center-level system and marry it up with our plan offline. And that’s the report the project managers use . . . to status variance. (Project Manager E, interview transcript 2-26)

Exceptions – Project Managers Drawing on Managerial Rationalism to Guide Project Tracking: Although the logic of managing variance was dominant form of institutional logic among many project managers we interviewed, the use of shadow systems and periodically reconciling activity does not appear universal in the project management community. One project manager in particular does not see her task as tracking variance, rather, she sees it as guiding activity through incentives – “programs are milestone driven. They have to show progress against milestones, they have to justify their existence, they have to be able to show that they’re going to be able to produce something at the end.” (Project Manager C, interview transcript 2-12) This project manager believes that project activity can be better disciplined to meet targets through rewards for meeting cost and timing objectives, as well as penalties for going over, as the following two quotes indicate:

You try and get researchers that’ll buy into the fact that they can accomplish research in a project schedule...“Well if that’s the only way I can get my research funded, I’ll agree to it, but grudgingly”... So, in that regard we tried to that and, you
know, as far as being able to incentivize or reward the researchers, in the last couple years our Project Manager tried to allow more travel to conferences and things like that so that they could go and make contacts and, you know, maintain their exposure [if they made their milestones]. (Project Manager C, interview transcript 2-12)

Interestingly, this project manager indicates that she is involved in a “concerted effort” with the business and implementation teams to adopt the ERP system appropriately. Rather than simply tracking project variance, she is attempting to reduce project variance and align activity with the budgets and milestones specified in the system. This does not mean that the project manager is entirely enthused about the system. Quite the contrary – she indicates that the system is not user friendly, it consumes a great deal of her time, and that she must constantly seek assistance in using the ERP system.

**Procurement for Research & the Logic of Scientific Professionalism**

Scientific personnel of the performing organizations are highly educated and narrowly focused in their fields of expertise. Many note that they joined NASA because of the glamour of space and their fascination with research that “pushes the envelope.” PhDs among researchers are common, and when asked what they do, highly technical replies were often forthcoming. Researchers at NASA Glenn focus largely upon technical concerns associated with groundbreaking discoveries in areas such as propulsion, communication and materials science. Their research cannot be controlled procedurally, but activity is dictated by the norms of the relevant profession, scientific method, and the practices of design and experimentation. Researchers see their professional identity in the field of their own expertise equally important and see often
programmatic goals pursued by the strategic enterprises as a way of getting funding to pursue their own research agenda. For them, raising the temperature tolerance of the high-temperature composite material that they have been working on since the 70’s by a few degrees (and thus publishing in a premier scientific journal) is just as important as the development of next rocket engine using the material. In those areas where control of activity may be in order, the logic of the scientific profession minimizes the contribution of such activity.

The sentiment associated with the logic of the professionalism of science is that the work of the researcher is the important, “real” work of NASA, and that any distraction from this is wasteful. There is a general notion among researchers that their activity is more valuable than administrators or project managers, “because there’s those who control and those who want to get stuff done” (Research Lead, interview transcript 2-11). Researchers consider themselves to be those who “get stuff done.”

Throughout the course of their professional efforts, researchers often need to purchase items to support their research – from supplies to computer hardware and software to external contracts for research activities. In the past, researchers submitted paper purchase request forms to clerical staff, who in turn managed purchasing activity. As part of the ERP system implementation, researchers are expected to conduct all of their purchasing activity directly with the ERP system.
Table 6: Logic of Scientific Professionalism

<table>
<thead>
<tr>
<th>Inst. Logic Dimension</th>
<th>Characterization of the Logic of Science</th>
<th>Representative Quotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles</td>
<td>Science - specific technology</td>
<td>Showing that you’re advancing the state of the art. (Researcher G, interview transcript 3-2)</td>
</tr>
<tr>
<td>Assumptions</td>
<td>Evidence of capabilities/results enable further research</td>
<td>It’s always been a matter of identifying what we’ve been able to do and show what other people in the industry or academia have done to show, “Okay, this particular capability can give you this.” (Researcher F, interview transcript 3-4)</td>
</tr>
<tr>
<td>Identity</td>
<td>Scientist performing a specialized &quot;craft&quot;</td>
<td>Researchers want to professionally develop and to do their craft…the researchers they want to present their work or be able to interact with other researchers. (Researcher F, interview transcript 3-4)</td>
</tr>
<tr>
<td>Domain</td>
<td>The technical domain of inquiry - &quot;real work&quot;</td>
<td>We’re not an industry; we’re not a “for profit” organization… We’re not about saving money here. (Researcher C, interview transcript 2-17)</td>
</tr>
</tbody>
</table>

Researchers’ responses to the ERP system are, however, mixed. Some circumvent the system entirely – using credit cards to purchase items, when possible, and thus following a completely different procedure. In certain areas credit card use is either inappropriate or limited by management, and many researchers work through a single administrative person for purchases rather than interface directly with the system. In one case, a researcher who initially signed up as a “super-user” and was first to be trained, indicated that he later fully mediate his system use through an administrative person:

_We have an executive assistant to the division chief who is primarily responsible for inputing procurement requests… researchers can do it and some of them do… it takes more [of a researcher’s] time to work that system and to work issues associated with that system. It takes away from their ability to actually do research. (Researcher B, interview transcript 2-11)_

The issue is not the abilities of the individuals – as researchers are highly technical people who often interface with extremely complex systems. The “super-user”
mentioned above does not avoid the system based on inability, but rather, on the principle that it takes away from his time doing research. Other researchers express an element of disdain for work that was not contributing to research goals. One researcher put it rather clearly when he indicated that researchers are “buying toilet paper… literally… that are high paid people” (Researcher C, interview transcript 2-17).

**Exceptions – Scientists Drawing on Managerial Rationalism for Procurement:**

Although the logic of scientific professionalism was the dominant institutional logic among many researchers we interview, a good number of researchers do directly use the system to do their own purchasing, just as the implementers of the ERP system intended.

In one case, the researcher compares the new system to the previous paper-based purchase request form. He identifies administrative duties as part of his job, and feels that his position requires him to be concerned with “accounting, budgeting, and resource management” activities (Researcher A, interview transcript 2-5). This researcher indicated that adoption of the system for purchasing activity is not unproblematic, and he indicates that he addresses this through “cheat sheets” and grouping purchases together at a single time:

_A co-worker of mine – came up with a “cheat sheet” and “click this” and “fill in this” and “do that”… I try to avoid it until I have a bunch of things I need to order… And so these I do, like I said, about once a month, so not being a frequent user and this not being an intuitive interface for me, I usually get out my cheat sheet to create a thing._ (Researcher A, interview transcript 2-5)
Budget and Time Tracking & the Logic of Organizational Persistence

Under the new regime of ERP and “Full Cost” activity-based accounting system embodied in the ERP system, each center and each research group is constantly challenged to justify its existence. In the old regime, Congress appropriated separate budget for NASA personnel, in addition to the budget items for seven strategic enterprises. This dual budget system was seen as one of the root causes of NASA’s inability to account for its expenditure on International Space Station as project budget for ISS did not include NASA employee salaries and other indirect cost. Under the old accounting system, the payroll of each center was more or less protected through highly political processes that involve local centers, elected local officers and local and federal legislators.

With the new accounting system implemented through the ERP system, however, all the payroll budgets were rolled into the program and project budget. Each center now must compete for the project budget in order to maintain its workforces. Under the new system, all hours of research, engineering, and service pool time must be billed either to a specific program or to a catch-all G&A account for each center. Tracking researcher time is an attempt to more tightly couple their activity to the specific projects and programs. If a particular researcher or service pool resource (e.g., a wind tunnel or zero gravity tower) are not being fully utilized by projects and programs, they are billed to the G&A account. Thus, researchers that bill a large proportion of their time to G&A may call to question their importance. Centers that need to maintain unique yet infrequently demanded resources (such as wind tunnels) face a particular challenge to promote and preserve their expertise and unique resources by aligning those resources with
programmatic demands from the seven enterprises. In that process, the center management must consider its long-term programs of radical innovation and associated efforts in ground-breaking pure science. Although these areas may prove vital to NASA’s mission later, many of them may not directly impact NASA’s current mission. One Glenn manager points out the indeterminacy associated with NASA’s competencies, offering the following “tribology” research example:

We have this, I would say the well known, probably the only Government group left in tribology area and this are a group of people that were well known in the country and in the world. But in the last couple years we just simply…the NASA program doesn’t look for that kind of expertise. So that group has not been getting funding... But we decided that we want it because they are the best in the world, they are the best in the country and we are the only Government left that are doing that type of work. So we decided that we want to maintain that core competency... And then when we had this Columbia incident, guess what, now they are looking for people who have the tribology expertise... Now they are in big demand. (Center Director A, interview transcript 1-13)

With the new system in place, many Center managers identify certain practices associated with “juggling” their efforts to keep these critical competencies and resources funded and their responsibility to keep their budget and expenditure in line with the stated programmatic goals of programs. Sometimes, they must keep unpopular groups “below the radar” to keep them going until one day they are vindicated.
Table 7: Logic of Organizational Persistence

<table>
<thead>
<tr>
<th>Inst. Logic Dimension</th>
<th>Characterization of the Logic of Competencies</th>
<th>Representative Quotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles</td>
<td>Promote and preserve competencies in the center</td>
<td>You want to make sure your people are gainfully employed, and then you want to keep the competency that you have, and then you want people to work on things that they enjoy working on. (Researcher F, interview transcript 3-4)</td>
</tr>
<tr>
<td>Assumptions</td>
<td>Need to win funding in order to maintain research.</td>
<td>So the big challenge is to have enough funding so that you can maintain long-term technical superiority in specific areas so that you’re kind of a focal point for people to go to and for future funding. If you’re not good at anything you’ll have a hard time winning anything. (Research Manager C, interview transcript 2-11)</td>
</tr>
<tr>
<td>Identity</td>
<td>The role of the centers is primarily research</td>
<td>Go out and look at the sign. It’s the &quot;Glenn Research Center.&quot; (Glenn Executive A, interview transcript 2-12, emphasis on the word “research”, distinguished from business)</td>
</tr>
<tr>
<td>Domain</td>
<td>Center managers charged with protecting the capabilities of NASA</td>
<td>You might have facilities that those specific programs don’t need, but if you sit back and think about it, you can see that ten years from now it’s gonna be a critical facility, and there isn’t another like it. We can’t afford to tear it down. (Glenn Executive B, interview transcript 1-22)</td>
</tr>
</tbody>
</table>

To center administration and managers of research groups, it is critically important that their center and research group appears to be competitive and efficient. In order to do so, managers often try to minimize the time billed to G&A to make their groups look better. Looking better was important, as groups are under pressure to put forth the best possible appearance in order to justify their existence and thus be able to court further work and the associated funding in the future. This “Logic of Competencies Self-preservation” (see Table 7) tended to be based on the assumption that the research work of any given group was important and that the group’s researchers were valuable and that the groups technical capabilities must be maintained. In the case of a high-level research manager, he rationalized billing G&A researcher time to projects as follows:

You ask employees to charge all their time to a project and they push back saying, well the time we spent at a branch meeting, we can’t charge that to a particular
project. I say, spread it across ... may not directly be in support of a project, but indirectly they support, they make you a more knowledgeable person about the things that are happening at the center. So ... some benefits to a project. (Glenn Division Chief A, interview transcript 2-19)

Reflecting this rationale in time-reporting activities, many researchers look to categorize as much activity as possible in line with the programs:

Well, if you’re going to charge to overhead tasks, it looks like you spent a lot of time on something and didn’t get much done. Don’t charge to overhead because it makes us look bad. It’s better off to have the people look like they cost less and that they’re inefficient than it is to have the people cost more but when they are working a task, they’re efficient. (Researcher D, interview transcript 3-2)

Furthermore, since the various research programs and associated expenditures occur at an unpredictable pace, yet programs are managed in well-defined milestones, many center managers keep a separate set of books to manage their budgets, only to reconcile them periodically with the ERP system. For example, one executive allows a staff member to shuffle funds between budgets to enable activity as required while still appearing to be within budget to the system:

If you’re the head of an office and you’re running low on money, you can come to the Budget Meeting and say “Look, I need this money” and I can say “Well, I know so and so has it and he’s looking for travel money... Each month I reconcile it back. So you can cut deals among each other or I can reallocate money, and my boss has given me pretty much full authority to do what it takes to get it done... So, basically he allows me to go ahead and work the budget so that everybody’s satisfied. “You
know, [informant’s name] I’ve got a problem I need $4000 to do XYZ”. … “Let me see where I can dig it out” … “I noticed that the contract’s running behind plan, do you mind if I give so and so $4000?” “Sure, go ahead.” (Administrative Person A, interview transcript 2-9)

Thus many of the Center’s managers reconcile budget activity outside of the system with the numbers they report to the ERP system. This activity is in part motivated by the desire to keep competencies alive within the organization.

Exceptions – Managers Drawing upon Managerial Rationalism for Budgeting and Time Tracking: There are other managers, however, that indicate that perhaps the mission of NASA is changing, and that many long-term competencies that are not concretely tied to projects might be better eliminated. For them, ERP and associated new budget process is a perfect tool to accomplish this rationalization:

I know that there are many people that want to say that well gee, we have these core competencies in these areas and it is our responsibility to maintain them but does anybody care that you have these core competencies?... But, I think for the betterment of the entire organization and the betterment of even them, it would be an improvement working on something that is going to be required some day. There have been instances at this center where I’ve seen people do technology work until they retired and then when retired, nobody picked it up. (Glenn Division Manager A, interview 3-1)

This Center manager strongly believes in the assessment team that has been put in place to evaluate potential competencies, and she believes that this team will not fall for
repackaged “spin” that has been common in the past. While she does not use the system herself, she does expect it of her staff, and expects that it will make the overall organization more efficient: “I think that people see that each individual can acquire more information and use that information and lessen the amount of time that is required to actually put together this report because [the ERP system] does this for you. It allows you to spend more time on the phone with the program office, with people across the lab as far as the implementation organizations, to get everybody on the same page.” (Glenn Division Manager A, interview transcript 3-1).

While certain groups circumvent the imperatives of the Full Cost initiative, through creative interpretation of its standards, other managers, however, insist that researchers report their time faithfully. One such manager comments:

_I think a very positive change, again, is everybody using same tool and same, working off the same data base. So, the change, the change that I see is people are trying to change their mindset... that [the ERP system] is here to stay, so we cannot sub-optimize or customize yet again ... We are strongly encouraged not to do that. We’re telling people not to do that. And, so, eventually, in time, everybody will be comfortable with the [ERP] reporting system, or the way [the ERP system] operates._

(Glenn Deputy Director A, interview transcript 1-22)

Similarly, while reporting all time to projects appears to be the universally-accepted practice, many managers do not justify it unproblematically such as the manager mentioned above:

_Generally people are told to charge their time to either the project they just finished or the one that’s coming up because they want to keep their overhead rates down._
Supervisors who never had anything to do with the test – don’t even know what the test is about – are even charging their time to the projects, too and so you end up with [a skewed] number of what it really costs to run a facility or to do a test. (Research Manager D, interview transcript 2-17).

Also, a number of researchers used fairly strong language to describe what they thought of allocating overhead activities to projects as lacking “integrity” and a “conflict”, using terms such as “lying” (Researcher F, interview transcript 3-4). In the case of the researcher who also espoused the logic of control in the purchasing activity above:

There’s still attempts, it looks to me, at the lowest level to hide what really goes on, to mask the amount of overhead that the researcher is burdened with so that we look good on paper...there are a lot of things that we’re asked to do that don’t have charge codes and we’re told just to charge them to the projects... Well, we feel like we’re lying when we’re reporting our time. So how does that meet NASA’s standards? (Researcher B, interview transcript 2-11).

Discussion

A fundamental assumption often associated with the implementation of an enterprise system is that the system can integrate a variety of dispersed local practices in an organization, and thus tightly couple these practices together through the visibility and control enabled by the single standardized database of the system. However, contemporary organizations are made up of a heterogeneous set of individuals and groups with often incongruent and goals, objectives, and rationalities. That is, contemporary organizations are subject to institutional pluralism (Kraatz & Block 2008). Furthermore,
our case study illustrates how these conflicting institutions co-exist by virtue of their loose coupling (Meyer & Rowan 1977). Next we will briefly explore the activities that maintain this loose coupling to generate a framework for generalized mechanisms of loose coupling, then we will discuss the way NASA’s institutional pluralism is manifest in our data, followed by implications for research and practice.

Three Mechanisms of Loose Coupling

Given the existence of multiple and diverse institutional logics that influence individuals actors at NASA in a variety of ways, how do individual actors in NASA reconcile different institutional logics and maintain a sense of coherence in their work practices? Our literature review suggests that loose coupling is a prevailing mechanism for such reconciliation. Our findings not only confirm the existence of such loose coupling, but further suggest four generalized forms of loose coupling.

<table>
<thead>
<tr>
<th>Form of Loose Coupling</th>
<th>Description</th>
<th>Level of Analysis</th>
<th>Relevant ERP Benefit Compromised</th>
<th>NASA Example &amp; Enabling Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal</td>
<td>Time lag</td>
<td>Process</td>
<td>Real-time data</td>
<td>Project tracking: Systems used for project management periodically reconciled with enterprise system</td>
</tr>
<tr>
<td>Material</td>
<td>Physical redundancy</td>
<td>Technical</td>
<td>System / application integration</td>
<td>Budgeting: Shadow systems (spreadsheets) to track actual budgets</td>
</tr>
<tr>
<td>Structural</td>
<td>Mediated interaction</td>
<td>Organizational</td>
<td>Universal system use</td>
<td>Researcher procurement: Mediated researcher system use; circumvention through bank cards</td>
</tr>
<tr>
<td>Interpretive</td>
<td>Sensemaking</td>
<td>Personal</td>
<td>Control &amp; visibility</td>
<td>Time reporting: Individual sensemaking; creative interpretation in time reporting</td>
</tr>
</tbody>
</table>
First, as seen in the previous section, many project managers loosely couple their tracking and reporting activity by periodically extracting data from the system and using this data within their own local applications. Similarly, in the example of bank card purchases, researchers avoid the purchasing process entirely and only later reconcile it with researcher budgets. Although in both of these cases the data in both systems may be the same at the point of extraction or reconciliation, this data is not continuously updated and made visible – there is a lag in responsiveness of certain organizational elements and the system. Here, *temporal* loose coupling between the ERP and local practices are used to reconcile the conflicting institutional logics.

Also, there are cases where individual actors resort to a third system to mediate ERP use. Here, NASA does not enjoy the single point of data capture and reduced manual coordination activity associated with tight coupling of organizational activities, or “process integration” expected from the implementation of an enterprise system. Here, we see *material* loose coupling where technological artifacts are used to resolve the conflicts between institutional logics of ERP and local practices.

In another example, we found that researchers do not typically use the system for their purchases, but instead appoint a single individual through which to mediate their system usage. In many cases, this appointed person often is a “super user” who received early training in the same local group. However, in other cases, we saw an emergence of new category of positions as a result of ERP implementation. For example, Glenn Research Center temporarily recruited two of its purchasing specialists to train researchers and engineers how to properly purchase through the system. Even though their official role as a trainer was over, they found themselves continuing to deal with a
stream of questions and requests from engineers and scientists for various types of purchasing requests that were rejected by the system. Often they ended up fixing the problems themselves, after learning what researchers and scientists were looking to do. Many scientists and engineers soon learned the “trick” to fool the system to accept an incomplete order, knowing that these two purchasing specialists will call them to complete the purchasing order through the system. The purchasing department eventually made their new positions permanent - system usage is now mediated rather than universal. Here, we see structural loose coupling where new roles are established in order to resolve tensions between the institutional logic of ERP and that of local practices.

Finally, center administrators process budgetary data outside of the system to make reported budgets fit with projections, and research managers creatively interpret time reporting mandates to encourage researchers to bill more of their time to funded projects. In both of these cases, for any given period, data reported in the system may, in fact, vary widely from the activity it is intended to represent. Thus the control enabled by tight coupling of organizational activity to an enterprise system (Ciborra 2000; El Amrani et al 2006) is ostensibly weakened by interpretive loose coupling.

Table 8 summarizes the four forms of loose coupling we identified in our analysis of NASA’s ERP implementation. These four forms are not mutually exclusive, as for example the temporal and material forms are both evident in the project tracking process. However, they enable us to be more precise in articulating the ways in which loose coupling can be maintained when an enterprise information system is introduced into an institutionally plural organizational environment.
Institutional Pluralism and NASA

In addition to eliciting generalizable forms of loose coupling, we identified a number of institutional logics at play in NASA, and we looked to understand how they relate to the enterprise system implementation. In the literature, enterprise systems have been characterized to embody a highly rationalized institutional logic (Gosain 2004), which is associated with values of efficiency and control (Ciborra 2000). Our analysis of NASA’s enterprise system is consistent with this characterization – but it is important to note that the enterprise system implementation does not spring up from purely internally motivated technical concerns. It occurs in conjunction with presidential initiatives that encourage governmental agencies to act more like businesses. Also, it occurred in the wake of audits from government agencies that require better accountability and control from NASA. Together, these initiatives indicate that NASA is under institutional pressures in line with the well-established institution that can be called “managerial rationalism.” According to Townley (2002), managerial rationalism, when applied to government agencies, involves business planning and a focus on performance through “myths of efficiency, value for money, improved management competence and increased management accountability, and greater control over public expenditure and, through this, an enhanced legitimacy for government” (p. 169). The institution we refer to as managerial rationalism appears under different names throughout a variety of institutional analyses, such as “bureaucratic rationality” (Meyer & Rowan 1977) and “managerialism” (Kitchener 2002). Managerial rationalism stands in contrast to practice-based institutions that involve the crafts or professions – what Meyer and Rowan (1977) describe as “categorical rules” apply to professions, which informally, normatively guide action that
cannot be readily rationalized. Institutional logics associated with professions are widely characterized to conflict with the logic of managerial rationalism (e.g., Townley 1997; Kitchener 2002).

<table>
<thead>
<tr>
<th>Locus</th>
<th>Logic</th>
<th>Related Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise System</td>
<td>Logic of Managerial Rationalism</td>
<td>Managerial Rationalism</td>
</tr>
<tr>
<td>Project Managers</td>
<td>Logic of Project Management Professionalism</td>
<td>Project Management Profession</td>
</tr>
<tr>
<td>Researchers</td>
<td>Logic of the Scientific Professionalism</td>
<td>Science &amp; Engineering Profession</td>
</tr>
<tr>
<td>Center Administrators &amp; Research Management</td>
<td>Logic of Organizational Persistence</td>
<td>NASA organizational unit (Center, performing organization, or office)</td>
</tr>
</tbody>
</table>

In the case of NASA, while some individuals draw on the institutional logic of managerial rationalism, many others draw on alternative, often conflicting institutional logic in response to the ERP implementation (see Table 9). For example, project managers and researchers indicated that the goals, assumptions and identities that drive their actions were not always consistent with the enterprise system. Many project managers identified with tracking variance of unpredictable projects, while many researchers were concerned with advancing the state of knowledge in their respective professional scientific fields. Neither of these logics was consistent with the linear, evenly parsed, and predictable imperatives of the enterprise system.

Beyond the professions, organizations themselves can evolve into institutional status in certain circumstances (Scott 2008). Certainly NASA as an agency is an institution within the wider institution of the U.S. Government. The centers have also attained institutional status as they are deeply implicated in local communities, the lives
of their stakeholders, and in local politics. As such, the survival of centers becomes an end in itself and this is evident in the espoused logic of the center managers who are looking to find ways to maintain the competencies of the center in the face of pressure to rationalize the center. On a smaller level, research groups within NASA reflect same drive for persistence.

Thus, our data supports our central thesis that: *in situations where the institutional logics that guide action are in conflict with the institutional logic of the enterprise system, that practice appears to be loosely coupled from the data in the system that is intended to represent that activity.* This analysis highlights how contemporary organizations are a nexus of heterogeneous institutional logics. It further shows how micro-level activity reflects the interplay of these broad societal-level institutions and how individuals reflexively deal with often conflicting institutional logics as they struggle to maintain a coherent identity (Friedland & Alford 1991; Thornton & Ocasio 2008). Each of the institutions we addressed represents ideologies, professions, and institutionalized organizations, and the activities we describe illustrate how practices relating to an enterprise system implementation are deeply embedded in this nexus of institutions. Through this institutional lens, we take a step toward identifying regularities and consistencies associated with situated, apparently idiosyncratic behaviors (Scott 1990).

It is important to note that in our analysis of NASA, the espoused institutional logics are not uniform across entire organizations, or even groups within those organizations. As individuals draw upon specific institutional logics to guide specific actions, there may be inconsistencies between such practices, resulting in their loose
coupling. We found that within three different groups – where there appeared to be a “dominant” institutional logic – there was inevitably a significant number of individuals espousing an alternative logic. In these situations their activity appeared to be more tightly coupled with the data in the enterprise system. For example, the center managers that espoused a managerial rationality did not report any shadow systems; the project manager that espoused the managerial rationality encouraged faithful project tracking; and the researcher who indicated that administrative activity was part of his job used the system directly for purchases. In the case of time reporting, researchers were required to attribute their time to projects. While this was not a problem for some, those who indicated that Full Cost initiative was appropriate for NASA experienced some dissonance (Bacharach et al 1996) at their loose coupling, as evidenced by negative attitudes (“we feel like we’re lying”).

Contemporary organizations do not maintain this integration and organizational coherence because individual actors in organizations share the same identity. To the contrary, our study suggests that organizations maintain its coherence through constant reconciliation between heterogeneous and often conflicting institutional logics that influence different pockets of actors in the organization. The integration among dispersed, idiosyncratic local practices, then, is an inherent dynamic process that always remains problematic. In that process, organizational actors do not lose their own unique sense of identity that defines who they are and their work. Instead, they can continue to deepen their own identity and constantly make sense of their purpose through mechanisms of loose coupling (Weick 2001). Such a pluralistic perspective is radical departure from the bulk of institutional research that treats organizations as singular
actors that identify with a single, or dominant, institutional logic (Gosain 2004; Currie & Guah 2007). Our work also extends the view that describes how local, situated groups and individuals idiosyncratically respond to enterprise system implementations (e.g. Ciborra 2000), as our analysis ties this idiosyncratic appropriation of technology to society’s broader institutions. Thus such idiosyncratic appropriations of technology can be understood through the multilevel connection of micro-level practices to society’s broader institutions.

Thus, the pluralistic institutional lens offers an alternative theoretical lens for stratifying organizational actors, beyond functional groups (e.g., Lawrence & Lorsch 1967) or communities of practice (Wenger 1999). Our analysis indicates that the assumption of group uniformity – either through functional groups or communities - may not be sufficient for “pluralistic” organizations (Kraatz & Block 2008) awash in multiple, often conflicting, institutional logics, and this is particularly relevant in an enterprise system implementation. The lens of institutional logics allows for differentiation within groups of responses to new enterprise systems, and also allows for differentiation within individuals in their responses to the system’s role in different practices, as different practices of the same individual may be guided by different institutional logics, as well as the same practice over time.

We highlight how a focus on the level of practice – rather than that of organizational groups or entire organizations – may be the appropriate level of analysis for understanding user responses to enterprise system implementations, given the power of individual human agency (Boudreau & Robey 2005) and the all-encompassing nature of enterprise systems. By identifying a set of institutional logics that an individual draws
upon to guide specific practice, researchers may be able to better understand individual responses to enterprise systems. In our analysis, we found that inconsistent institutional logics did result in misalignments, consistent with Gosain (2004) and Sia & Soh (2007), but these institutional theorists indicated that in order for this misalignment to be resolved, either the enterprise system must be customized, or the organizational practices must be adapted to the system. To the contrary, we found four instances of loose coupling where this tightly coupled alignment is not evident.

Furthermore, we identified four mechanisms that make this loose coupling possible across temporal, structural, and material domains (Table 9). Each form emphasizes alignment at a different level: material at a technological level; temporal at a procedural level, structural at an organizational level, and interpretive at a personal level. Because enterprise systems are intended to encompass activities across an entire organization, given the possibility of loosely coupled activities such as those we uncover, complete alignment with a system across an entire enterprise looks to be a challenging task, certainly in NASA. This is because alignment in an enterprise system context does not equate merely to stable system usage – if this were the case, then much of the activities reported here can be considered to be aligned.

**Conclusion**

Our findings should be taken as a source of caution to practitioners and researchers who view information technology as “softly” deterministic carriers of institutional forces. Institutional forces do not act upon a blank slate, void of incumbent institutional logics. Rather, actions of individuals are firmly rooted in institutionalized, path dependent organizational routines through which actors find meaning and base their
identities. If a new institutional force has a logic that is congruent with incumbent activity, alignment is quite possible after a period of mutual adaptation. However, if these logics are incongruent, alignment will be hard-won, as it will require a highly disruptive reconfiguration of identities and symbolic systems that will leave the individual’s practice fundamentally changed. Often such fundamental change may not desirable at all. In the case of NASA, it is clearly undesirable for researchers to give up their identity in the scientific professional community. In such cases, loose coupling serve as indispensible tool that keeps organization coherent through continuing reconciliation of conflicting institutional logics.

Our findings have several implications. First, while the data in an enterprise system is intended to represent certain organizational activity, in the wake of NASA’s ERP implementation, we found that it is fairly commonplace for the data to bear little resemblance to the activity it is intended to make visible and control. We explain this observation by identifying inconsistent institutional logics between those that guide individual practices and those associated with the system. Institutional theory informs us that practices become loosely coupled between inconsistent institutions, and we generalize forms of loose coupling in the context of enterprise systems implementation to be: temporal, structural, material, and interpretive.

While NASA is an extreme example, we hold that institutional pluralism is evident in every contemporary organization to some extent. Through the device of an institutional logic, researchers and practitioners alike can better understand user alignment with enterprise systems by uncovering individual goals and values, causal assumptions, sources of identities, and bounds of this guiding logic – and to link this
logic to society’s overarching institutions, thus capturing regulating influences in what appears to be emergent, idiosyncratic activity. Also, our analysis of individual practices rather than group or organizational level activity highlights human agency, in contrast to the common assumption of uniform group responses. Through a pluralist lens, we characterize an organization as a nexus of multiple, nested institutional logics that guide action. Organizational actors draw upon specific logics to guide their actions at the moment, form their identities, and make meaning in their daily activity. When an information system is implemented into an organization, it brings with itself the assumptions of a specific institutional order. However, the information system is inserted into an ecology of multiple existing logics of action. The information system will be congruent with similar logics – offering the potential for eventual alignment through mutual adaptation – or it can be incongruent with an incumbent logic, which would bring about loose coupling, fundamental change to the practice, or failure.
Appendix C - NASA’s Enterprise Information System as Loose Coupling: Integration, Control, and the Goal of Stability

Abstract

This paper presents a study of NASA’s ERP system implementation and the subsequent four years of adaptation. Using the lens of loose coupling in the context of business processes that the enterprise system is intended to integrate and control, we identified six different broad forms of loose coupling between the ostensive, material, and performative aspects of those processes. Through a grounded analysis of these loosely coupled misalignments, we generate twenty-two theoretical propositions about the direct effects of different forms of misalignments on issues relating to the integration, control, data quality, and satisfaction associated with the processes. Through this analysis we find that the twin enterprise system objectives of integration and control can in some cases be negatively related, as situations are described where efforts to resolve misalignments to increase one may negatively impact the other. Further, we argue that “stability” as a goal for enterprise appears as important, in some cases, as the well-established objectives of integrate and control, and that unresolved misalignment that reach stable states of “loosely coupled equilibrium” can enable this stability, and need not always be resolved toward “alignment.” Based on these findings, we conclude with the counter-intuitive argument that a tightly coupled enterprise system can, in practice be a mechanism for loose coupling, enabling legitimatization and tight integration on an organizational level, while allowing for locally situated actions subject to less-than-complete levels of integration and control.
NASA’s Enterprise Information System as Loose Coupling: Integration, Control, and the Goal of Stability

“Organizations as loosely coupled systems may not have been seen before because nobody believed in them. It is conceivable that preoccupation with rationalized, tidy, efficient, coordinated structures has blinded many practitioners as well as researchers to some of the attractive and unexpected properties of less rationalized and less tightly related clusters of events.” (Weick, 1976)

Introduction

In January of 2004, President Bush announced his “Vision for Space Exploration.” NASA will return to the moon, launch a manned trip to Mars, complete the International Space Station, and develop a spacecraft that will replace the space shuttle. Radical innovations such as these require decades of work, and NASA must deliver them by shifting resources from other efforts, within an unchanged budget, and in the context of increasing government oversight and involvement. To maintain long-term competencies required to deliver these innovations with such extreme time horizons, while still adapting to its turbulent, highly-politicized changing demands, many of NASA’s structures are loosely coupled (Vaughan 1996, Perrow 1984). For example, NASA’s ten centers have historically operated independently from each other, many research groups are virtually autonomous, and the possibility of close scrutiny by outside organizations has generally been limited due to the extremely specialized nature of the work.

Two months before the President’s announcement, NASA went live with an enterprise information system intended to tightly couple the Agency’s ten centers into a financially unified agency, to align organizational activities to the President’s space vision, and to
make details of NASA’s activity visible and more accountable to other branches of the U.S. Government. In one sense, NASA’s enterprise system implementation can be conceived as an effort to tightly couple a loosely coupled organization. In this paper we report on a post-implementation study of NASA’s enterprise system implementation, in an effort to understand the way that an integrated, controlled, “tightly coupled” enterprise information system plays out in a loosely-coupled context of radical innovation, high-reliability, and political turbulence.

Research into enterprise systems such as ERP, generally focuses on benefits of integration and control through tightly coupled organizational processes, functional units, and data (Davenport 1998; Markus and Tanis 2000; Barki & Pinsonneault 2005; Gattiker & Goodhue 2005; Srivardhana & Pawlowski 2007). The notions of integration and control are generally thought to be mutually-reinforcing and entirely consistent with one another, as process and data control through standardization enables the integration of processes and organizational units, which, in turn enables better organizational control and decision making through data visibility and the associated accountability.

While tightly coupled integration and control are the key goals associated with implementing an enterprise system, commentators increasingly argue that the goals of complete control and integration are elusive, at best, but more likely unattainable (Ciborra 2000; Dechow & Mouritsen 2005). The most notorious culprits that undermine the dream of complete control and integration are the inevitable loosely coupled “misalignments” that arise between the enterprise system and local practices throughout the implementation process (Soh et al 2000; Wei et al 2005). If there are a great number of misalignments, or particularly deep misalignments, the system implementation is
likely to fail (Sia & Soh 2007). Therefore, the prevailing view in both practice and research generally argues that organizations should look to resolve such misalignments, that is, more tightly couple organizational practices to the enterprise system over time, through adaptations of both the system and local practices (Soh et al 2000; Sia & Soh 2007; Light & Wagner 2006; Wei et al 2005).

With its focus on integration, control, alignment, and tight coupling, much of the literature on enterprise information systems generally adopts fairly mechanistic assumptions (Scott 1987) with regard to the systems themselves, and does not explicitly consider the decades of organizational literature on the merits of loose coupling. The term “loose coupling” indicates a situation where organizational elements are linked together and responsive to each other, but only partially so (Orton & Weick 1990). Looser coupling of organizational elements through slack, redundancy, and excess capacity, for example, can be a good thing for organizations in certain situations. It has long been held in classic management literature that loosely coupled structures enable organizations to better handle the equivocality and indeterminacy associated with innovation, environmental turbulence, and compliance with institutional pressures (Weick 1976; Meyer & Rowan 1977; Hannan & Freeman 1977; Pfeffer & Salancik 1978). A variety of organizational researchers across disciplines and perspectives emphasize, often implicitly, the importance of balancing tight with loose coupling of organizational elements for the organizational ambidexterity, reliability, and legitimacy that enables organizational survival over time (e.g., March 1991; Grabowski & Roberts 1999; Oliver 1991). Thus, in focusing on incidents of loose coupling in the wake of NASA’s enterprise system implementation, it is our goal to better understand how loose coupling
plays out over time, paying particular attention to the effects of loose coupling on enterprise system-related goals of integration and control, as well as the success of the system implementation in particular. We base our analysis on recent advancement in theoretical approaches to business processes (Pentland & Feldman 2005; 2003; Volkoff et al 2007), whereby we articulate a view of loosely coupled business processes where certain aspects of the process – the ostensive, performative, and material– are not in alignment. We chose business processes as our unit of analysis because enterprise systems embody a horizontal, process view of organizational activity (Davenport et al 2004, Kallinikos 2004; Volkoff et al 2005; Zammuto et al 2007), and therefore business processes are fundamental to enterprise system-related activities and outcomes.

In this paper we present our 4-year, two-phase, exploratory study of loose coupling in the wake of NASA’s ERP implementation. NASA is a particularly relevant context for the study of loose coupling and enterprise systems, because it is a highly complex organization that is driven by both loosely and tightly coupled imperatives (Perrow 1984). NASA is engaged in radical innovation on par with any terrestrial organization, while at the same time subject to acute reliability issues and the efficiency demands of an organization with limited resources (Starbuck & Farjoun 2005). Also, NASA faces political, regulatory, and reporting concerns associated with being a large high-visibility government agency. NASA is a prime example of an extreme case (Yin 2003) who’s highly publicized experiences resonate with a variety of organizational phenomena across industries (Farjoun & Starbuck 2007).

The remainder of the paper is organized as follows. First we assess the key assumptions prevalent in the enterprise system literature, and operationalize a view of loose coupling
between local practices and the enterprise system which we use to analyze our data. Next we present our two-phase analysis of two business processes where loose coupling was evident in our data, focusing on the way these situations played out over time. We then discuss our findings and present a multi-level model of the relationship between loose coupling, stability, integration, and control in an enterprise system context. We conclude with a paradoxical characterization of NASA’s tightly-coupled enterprise system as a mechanism for loose coupling.

Enterprise Systems: Integration, Control, & Misalignments

Large-scale, standardized enterprise information systems are implemented across a wide array of activities in and across organizations. The goals associated with enterprise system implementations generally involve the integration of the data driving these practices, and the resulting tighter hierarchical control of these activities (Davenport 1998; Dechow & Mouritsen 2005; Volkoff et al 2005).

The barriers to system-related integration and control are often characterized as “misalignments” between the system and organizational practices (Soh et al 2000; Sia & Soh 2007). There are a number of assumptions that are prevalent, often implicitly, in the literature concerning the notions of integration, control, and misalignments in enterprise systems contexts (see Table 1). Researchers frequently use and re-established these assumptions without evidence of critical appraisal and careful scrutiny. Thus, a key goal of this research to use a lens of loose coupling to both clarify the role of each of these concepts in an enterprise system context, and to gain insight about the assumptions that are prevalent in the literature. Next we will briefly introduce these assumptions (Table 1)
then address each one more fully, in order to create working definitions of these constructs and to develop our research questions.

<table>
<thead>
<tr>
<th>Table 1. Assumptions Associated with Enterprise System Implementation</th>
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<tbody>
<tr>
<td><strong>1. Integration &amp; Control</strong></td>
</tr>
<tr>
<td>1a The goals of enterprise system implementations involve integration and control.</td>
</tr>
<tr>
<td>1b The relationship between integration and control is mutually reinforcing</td>
</tr>
<tr>
<td><strong>2. Misalignments</strong></td>
</tr>
<tr>
<td>2a Misalignments adversely affect the goals of the enterprise system (i.e., integration &amp; control).</td>
</tr>
<tr>
<td>2b Misalignment should be resolved through mutual adaptation of the system and relevant practices.</td>
</tr>
<tr>
<td>2c Many or deep misalignments will hamper successful enterprise system implementation.</td>
</tr>
</tbody>
</table>

**1. Integration & Control**

As enterprise-wide standardized infrastructures, enterprise systems are intended to integrate certain processes across organizational units and functions through the common data associated with a unified set of applications that utilize a common database (Davenport 1998; Markus & Tanis 2000). While integration in itself is often treated as a key goal associated with an enterprise system (e.g., Barki & Pinnsoneault 2005; Volkoff et al 2005; Gattiker & Goodhue 2005), integration also drives other benefits such as efficiency across organizational practices (Shang & Seddon 2002), improved knowledge sharing (Srivardhana & Pawlowski 2007) and increased managerial control over organizational activities (Davenport 1998; Volkoff et al 2005). Since standardization is
the key enabler of integration (Light & Wagner 2006) enterprise systems are often characterized as instruments of centralized, rational management control over the relevant practices (Ciborra 2000; Elmes et al 2005; Kallinikos 2004; Gosain 2004). Paradoxically, while enterprise systems enable flatter, more “democratic” process-oriented organizational structures, they do so through an increase in centralized control. Enterprise systems allow hierarchical control of processes by both enforcing managerial standards into the system (Davenport 1998), and by providing the visibility of real-time data for managers to both monitor these processes, and to make informed decisions (Elmes et al 2005).

From a review of the literature, we find three broad types of integration, and two forms of control. First, Barki & Pinnsonneault (2005) define integration as “the extent to which distinct and interdependent organizational components constitute a unified whole” (p.166), which implies that these integrated components maximize their responsiveness to each other, are highly interdependent, and are, essentially, tightly coupled. Three broad forms of integration are evident in enterprise system contexts:

- **Structural integration, in an enterprise system context involves the tight coupling of organizational units (i.e., functional groups, business units, organizations) together** (Barki & Pinnsonneault 2005). This integration is enabled by tightly coupling the processes that cross both units.

- **Process integration in an enterprise system context involves the tight coupling of organizational activities (i.e., tasks, processes) together** (Berente et al 2009). This tight coupling is enabled by the use of common data.

- **Data integration in an enterprise system context involves the tight coupling of organizational data to the central database.** (Which, at a minimum requires common data definitions across organizational groups, see Goodhue et al, 1992.)
Thus the integration resulting from an enterprise system implementation is hierarchical. Organizational integration requires process integration, which, in turn, requires data integration. Therefore “common data definitions” (Goodhue et al, 1992) and complete and accurate data must be strictly adhered to in order to enable broad levels of integration. That is, there must be some element of control to encourage and enforce this standardized data input, often across entire processes. Further, organizations tend to operate under the assumption that this integration, in turn, bolsters management control over relevant organizational processes (Dechow & Mouritsen 2005; Ciborra 2000).

A commonly-used definition describes “control” as the “purposive influence toward a predetermined goal” (Beniger 1986, p.7). Using this definition, we see that centralized control is evident in at least two ways in an enterprise system context – guiding organizational activity through procedures that are enforced by the system (Kallinikos 2004), and visibility that allows monitoring of individual activity. Elmes et al (2005) refer to these as bureaucratic (process) and disciplinary control:

- **Bureaucratic control** in an enterprise system context involves control of relevant organizational activity in line with the practices implied by the system. This proactive form of control requires adherence to prescriptions associated with the systems, and is required for data integration.

- **Disciplinary control** involves the monitoring organizational activity to enforce proper organizational practices. This reactive form of control requires the data in the system to faithfully reflect the data used in organizational practices.

Through this discussion of both integration and control, we see a hierarchical relationship between the different forms of integration, and a recursive relationship between integration and control. Thus the twin objectives of integration and control appear to not only be consistent with each other, but also to be mutually reinforcing. However, the
integration and the related control associated with enterprise systems have proven to be elusive in practice (Ciborra 2000; Dechow & Mourtisen 2005; Elmes et al 2005), and next we will address the treatment of misalignments in the literature.

2. Misalignments

Researchers have long realized that information technologies, when initially implemented, do not necessarily fit well with organizational practices (Lucas et al 1988; Leonard-Barton 1988), and this is especially the case enterprise information systems. Enterprise systems encode a set of generic imperatives, or “best practices,” that are intended to be configured to fit local contexts (Markus & Tanis 2000; Wagner et al 2006). Because of the pressure for software vendors to provide systems that are as widely applicable as possible (Sawyer 2001), these generic practices that are intended to fit within all contexts in reality fit well with very few and gaps inevitably arise in certain local contexts between practical needs and capabilities that cannot be readily addressed by system configuration (Light & Wagner 2006). Thus, immediately after implementation, practice is often loosely coupled in some way from the system, enabled in the short term through improvisational activities (Boudreau & Robey 2005; Ciborra 2000), and eventually may involve customization of the system, changes in organizational practices, or both, in an effort to more tightly couple practice with the system (Sia & Soh 2007; Soh & Sia 2004).

Loose coupling between practices and enterprise systems – often described as “gaps,” “misfits,” or “misalignments” - is a central theme for research in enterprise systems. Loose coupling can reflect a number of pressures, ranging from technical issues (Wei et
al 2005) to overarching business imperatives (Davenport 1998). In local contexts, loose coupling results from a variety of conflicting forces associated with enterprise system implementations, such as conflicts associated with competing epistemic cultures (Wagner & Newell 2004), conflicting values (Allen 2005), power struggles (Scott & Wagner 2003) and institutional clashes (Gosain 2004; Soh & Sia 2004; Sia & Soh 2007).

According to the bulk of literature on enterprise systems, loose coupling between the system and organizational practice inspires a process of mutual adaptation to resolve the loose coupling. The image of mutual adaptation (Leonard-Barton 1988 – see Figure 2), is one that is widely utilized in the information systems discipline at large (i.e., Tyre & Orlikowski 1994, Orlikowski 1996; Lyytinen & Newman 2006), as well as research that specifically addresses enterprise systems (i.e., Soh et al 2003; Gosain 2004; Light & Wagner 2006; Sia & Soh 2007). Since enterprise systems rarely fit existing practices immediately, mutual adaptation involves cycles of change to both the system and existing practice, eventually resulting in alignment between practices and the system, or, in the least, progress towards the eventual promise of alignment. Throughout this stream of literature, loose coupling between the enterprise system and practice are treated as problems that should be resolved (Wei et al 2005; Light & Wagner 2006; Volkoff et al 2005; Sia & Soh 2007). In the image of mutual adaptation, some form of equilibrium is the desired state, and failure to realize this equilibrium equates to a failure of the system (Lyytinen & Newman 2006).
Thus, from our review of the literature on misalignments, we find that misalignments are generally thought to undermine the goals associated with an enterprise system – integration and control – and therefore must be resolved through a process of mutual adaptation and eventual alignment. If there are too many misalignments, or if these misalignments are particularly deep, then the enterprise system will likely fail (Davenport 1998; Sia & Soh 2007).

**Misalignments as Loose Coupling**

The ubiquitous misalignments in enterprise system contexts can be characterized as “loose coupling” between the enterprise system and existing practice. Loose coupling refers to patterns of action that are distinct, or separate from each other, yet are still responsive to each other in some fashion (Orton & Weick 1990). Loose coupling is a dialectic concept intended to offer an alternative to both tightly coupled and decoupled system concepts. Tightly coupled systems are highly integrated and responsive to each other, while non-coupled systems are completely separate and unresponsive (Orton &
Weick 1990). The concept of loose coupling is rooted in an open systems theory of organizations that views organizations as collections of partially-connected subsystems, which are, at the same time, partially connected to their environments (Scott 1987).

Thus, while an enterprise system may be in use across an organization, misalignments at different points of various organizational processes evoke the image of loose coupling between the enterprise system and the relevant practices. However, the term “misalignment” implies something negative and undesirable, something that must be resolved. In characterizing misaligned situations as loose coupling, one might see that a misalignment is not always a bad thing. Loose coupling can be beneficial to an organization. For example, loose coupling is its many forms generally enables local adaptivity, organizational flexibility, and the simultaneous fulfillment of conflicting demands (Weick 2001). However, these benefits are generally characterized to come at the expense of efficiency and execution, especially in contexts of greater certainty.

Thus there is a tradeoff evident in loosely coupled situations. In the enterprise system research, the disadvantages of loose coupling are well articulated, but the advantages of loose coupling in this context go unaddressed. To resolve the need for a understanding these tradeoffs, we studied NASA’s ERP implementation over four years to appraise the five assumptions commonly associated with enterprise system implementation that we identified in Table 1.

1a What are the tradeoffs associated with loose coupling in light of the goals typically associated with enterprise system implementations (i.e., integration and control)?

1b How does the presence of loose coupling relate to the mutually reinforcing relationship between integration and control?
2a What are the direct effects of different forms of loose coupling – particularly on the key variables of integration and control?

2b Does loose coupling become resolved over time through mutual adaptation?

2c What are the organizational effects of loose coupling, specifically in terms of enterprise system success?

We use these questions to guide our analysis of NASA’s ERP implementation in an attempt to generate theoretical insight about the way different forms of loose coupling play out in an enterprise system context. Next we will briefly detail our operationalization of loosely coupled misalignments, and then present our findings.

Operationalization of Loosely Coupled Misalignments

In light of the varied usage of the term and the inconsistency of the reports relating to consequences, when studying loose coupling it is important to be very clear about the elements in question, the manner in which they are loosely coupled, and the consequences of interest (Orton & Weick 1990).

Through the notion of misalignment, we have established the importance of loose coupling between what we have bluntly characterized as “practice” and “the system” to the study of enterprise information systems. However, it is important to be more specific about what, precisely, is loosely coupled or misaligned. These are the elements that Beekun & Glick (2001; Weick 1976) indicate are essential to identifying loose coupling. Recent research on enterprise systems offers a vocabulary for greater precision in the way researchers can characterize the degree of coupling between practices and enterprise systems (Volkoff et al 2007, see Figure 3).
Business processes are the critical unit of analysis (or Beekun & Glick’s 2001 domains) for understanding the impact of enterprise systems; as such systems take a process view of organizations (Davenport et al 2004; Kallinkos 2004; Zammuto et al 2007). Two important aspects of business processes: the performative and the ostensive aspects\(^{10}\) (Feldman & Pentland 2003). The ostensive aspect captures the way individuals view the process, how they think about the process, and how they account for activities in the process. The performative aspect of processes involves the situated carrying out of organizational tasks. “The ostensive aspect of the routine is the idea; the performative aspect, the enactment.” (Feldman & Pentland 2003, p.102)

To better understand the relationship between enterprise systems and business processes, Volkoff and associates (2007) adds the *material* aspect of organizational routines. In their view, the material aspect embeds and directly influences the performative aspect,

\(^{10}\) Feldman & Pentland use the term “routine” following Nelson & Winter 1982, however, as Pentland (1995) indicates, the terms “routine” and “business process” can effectively be used interchangeably.
representing the portion of the performative aspect of the routine that is “executed by the technology” (p.840). The material aspect of the process, in the form of an enterprise system’s technical implementation, can theoretically bring the ostensive and performative aspects of processes.

From this view of the process, we have three broad dimensions along which processes can be loosely coupled (see figure 3), or, what Beekun & Glick (2001) describe as the content of the loose coupling: (1) ostensive-material coupling, (2) material-performative coupling, and (3) performative-ostensive coupling.

1. **Ostensive-material coupling (O-M)** involves the relationship between the technical features of the enterprise system and the way they reflect the goals and principles associated with the system’s role in the process. Tight ostensive-material coupling would involve perfect correspondence between the technologies structure and the goals for the technology. In such situations, process maps, for example, would perfectly embody goals and principles associated with the process and maintain a one-to-one correspondence with the technical features in the system. Loose coupling along this dimension, on the other hand, implies that this is imperfect correspondence, and that the technological features do not align with the goals of the system in some way.

2. **Material-performative coupling (M-P)** involves embedding of relevant processes into the enterprise system (Volkoff et al 2007), so that the relevant aspects of these processes are executed in the system. Tight material-performative coupling would indicate that users appropriate the system as the tool by which they carry out the practices associated with the business process. In the process map example, the technology is in fact used at the points specified in the process map. Loose material-performative coupling, on the other hand, indicates that the performative practices associated with a business process may inappropriately, improvisationally, or partially use the technology.

3. **Performative-ostensive coupling (P-O)** involves the manner in which the enacted practices associated with a given process correspond to the goals and principles associated with the process. In this sense, does the overall process correspond to the process map? Tight performative-ostensive coupling would indicate that the process is consistent not only with the goals and principles associated with the process, but also the explicit sequence of activities and related decision criteria.
In their theory of enterprise system mediated organizational change, Volkoff et al (2007) argue that the material aspects of a process in the form of an enterprise system drive, to some extent, the performative aspect of the process to more closely align with the ostensive aspect.

**Research Method**

We conducted a two-phase field study across 4 years of NASA’s agency-wide implementation of an ERP system. The objective of the study was to understand individual responses to an enterprise system implementation through the practices of those individuals. As revelation rather than generalization is the goal for this research, a single, extreme, case was deemed adequate (Yin 2003). The research proceeded in two main phases, and involved 110 interviews. NASA went live with the ERP system in 2003\(^\text{11}\), and in our first round of data collection (2003-2004) we conducted 68 interviews throughout Agency Headquarters in Washington D.C. and two different centers. Then we returned to NASA in 2007-2008 and conducted 42 interviews, many with the same people, but often with different people in the same or similar positions.

Data were collected using open-ended interviews (Yin 2003) typically one hour in duration. Because the research deals primarily with personal perceptions of individuals about the enterprise system implementation and their tactics for reacting to this implementation, strictly structured interviewing did not apply. Rather, we looked to understand specific events and their contexts before embarking on any given line of

\(^{11}\) Actually, portions of the core financial module have been operational in the financial organization since 2000. 2003 marks the go-live to the rest of the Glenn and Marshall Centers.
questioning. Therefore, interviewees were treated more as “informants” than “respondents” throughout the interviewing process (Yin 2003; p.90). The interviews were not entirely unstructured, as informants were asked to bring examples of positive and negative experiences associated with the enterprise system implementation with them to the interview. During the interview, we followed a general process of asking personal information about the individual, her position, and the activities that she engages in on a regular basis. Then two broad areas of the enterprise system implementation were specifically addressed through open-ended questioning, namely, the Integrated Financial Management (IFM), and the Full Cost Program, which is activity-based costing enabled by ERP. A research database and central repository were created for the research project (Yin 2003). The research repository included every transcribed interview, as well as all digital documentation and a number of internal NASA reports about the implementation, as well as audit reports concerning the enterprise system implementation from the U.S. General Accounting Office (GAO), the NASA Advisory Council (NAC), and the Inspector General (IG). In order to triangulate our interpretation of the events (Yin 2003), a full case write-up was collaboratively created by the authors and submitted to NASA management. They agreed that our depiction of events was accurate.

The interview data were analyzed following Strauss & Corbin’s (1988) model of grounded theory development, which involved three rounds of coding with continuous iteration between the data and our theoretical interests (Eisenhardt 1989) for the first set of interviews. This iteration helped amplify our theoretical sensitivity (Strauss & Corbin 1998) through the extraction of themes such as ‘misalignments’, ‘logics,’ ‘loose coupling,’ and ‘reconciliation mechanisms’ (i.e. the ways in which loose coupling was
enabled). To organize and display the data we used ‘conceptually ordered descriptive matrices’ (Miles and Huberman, 1994), which are used to order qualitative data for subsequent clustering and partitioning. We operationalized these matrices through a Microsoft Access database that contained records with detailed information about each informant, which were then related to records containing that informant’s descriptions of misalignments, responses to the ERP system, and a variety of codes for the type of misalignment and type of response. Subsequent axial coding outputted to an Excel spreadsheet, combined with notes taken from non-interview data, supports our analysis of the initial data set. The second round of data collection was more focused and involved understanding the way in which specific instances of loose coupling played out over time. Transcriptions from the second round of data collection were organized using the codes generated by the analysis of the initial interviews and the literature, through Atlas.ti software (for qualitative data coding and analysis).

Finally, to aid in analyzing the data, we developed time-ordered descriptive matrices (Miles & Huberman 1994) based on the dimensions of loose coupling five dimensions of loose coupling (following Beekun & Glick 2001). Findings are presented through simplified matrices and supporting narratives.

A number of commentators caution against “arbitrary” assignment of time phases in longitudinal research (Miles & Huberman 1994; Pettigrew 1990; Barley 1986). Miles and Huberman (1994, p.111), for example, indicate that time ordering can be derived “by empirically derived phases or stages of the adoption or implementation process.” Barley (1986) indicates that one way to empirically derive such partitions is to demarcate them based on (1) changes that organizational members consider significant, and (2)
exogenous events that affect the phenomena of study. In following this path, we find two broad periods in the first round of data collection that were deemed significant by informants: (T1) “go live,” and (T2) adaptation activities immediately after go live. Also, we were sure to detail the state of the process before go-live to understand the context (Barley 1986) into which the enterprise system is implemented. These two stages are consistent with a variety of longitudinal IS studies (e.g., Majchrzak et al 2000; Tyre & Orlikowski 1994). Based on the second round of data collection, we partitioned data based on recollection of events since the last round of data collection across two phases (T3) and (T4) based on either exogenous changes, or internal changes. The third partition (T3) applied primarily to researcher purchasing, where we used the espoused importance to the informants as the criterion for partitioning: in these cases most of the changes reportedly occurred fairly soon after the initial round of interviews, the twelve months of June 2005 – 2006, the bulk of changes to researcher purchasing activity took place. In the project reporting activity, the fourth partition (T4) demarks an important exogenous change that occurred in 2006 – the discontinuance of Full Cost - which had substantial effects on this process.

Finally, (T5) indicated a stabilized current state, which in all cases was reportedly fairly stable in (at least) the year before interviews. Also, pictorial representations for each form of loose coupling over time was developed for strictly illustrative purposes, in an attempt to capture the image of mutual adaptation (Figure 1), and using notation based on that of Volkoff et al (2007). Next, before presenting our findings, we will briefly introduce the context of the NASA case study.
Context of Change

NASA’s decisions to implement an enterprise system did not occur in a vacuum. Rather, they were deeply linked to overarching changes within the organization. When referring to the role of the enterprise system in changes to NASA in the past five years, one researcher indicated that the enterprise system was merely “a noise” in the context of the changes during that time:

*It was an announcement by the President at NASA Headquarters that said we are going back [to the moon]. We’re going to start flying the shuttle again. We’re going to finish the Space Station. We’re going to take human presence and establish it on the moon as a means to go to Mars and then beyond... That’s the foundation of anything the Agency’s doing... from the atmosphere on Mars, that requires fluid physics, material handling, combustion or chemical reaction processes. Those fairly independent organizations now had to start working together. We had to start working together with very ill-defined requirements. We had to reinvent how we*
worked together. I can say that the whole [ERP] side of things, that was an aside, a noise if you will on us changing how we were working and our working relationships. (Project Manager E, transcript 2-11-08)

However, the cost of the initial implementation of the financial module alone was estimated at roughly $200 million in 2003, including the established the NASA “Competency Center” to maintain and support the system, that currently requires $45 million annually (Implementation Manager C, interview transcript 4-7-08). There was a great deal of work preceding the implementation, and NASA implemented a significant technical upgrade in the two years after initial implementation. In total, through 2009, the enterprise system implementation is expected to cost NASA $900 million (GAO 2007). Further, the key goal of integrated financial management involved managing budget funding across centers, enabling the economic infrastructure upon which researchers could “reinvent how they work with each other.” If the enterprise system is a noise, it is not a small noise. It is important, however, to note that this system is implemented in a context of other equal or even greater changes.

Four broad, organization-wide changes, resulting from many of the pressures described in the previous section, occurred over the course of our research. Perhaps the most important change for NASA was the announcement of the President Bush’s 2004 Vision for Space Exploration. NASA was now expected rebuild a space shuttle program, continue the space station, revisit the moon, and launch a mission to Mars – all on a budget that was largely unchanged ($16 billion in 2007). This required NASA to channel research away from “pure science” (primarily in Aeronautics Divisions) projects, toward “applied science” projects (in Space Divisions) that would deliver these goals. This

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transition toward these applied goals for exploration – which involved a complete restructuring of Aeronautics-oriented centers such as NASA Glenn - came in the context of four broad program changes across the tenure of two NASA administrators.

We will refer to each of these changes as: One NASA; Full Cost; Programmatic Budgeting, and Ten Healthy Centers. The first two were drastic changes to the way NASA traditionally did business, instituted by former NASA Administrator, Sean O’Keefe. The second two were adaptations of O’Keefe’s programs by Mike Griffin, who took the reins of the Agency in 2005\(^\text{13}\). Next we will briefly describe each one to contextualize our analysis of loose coupling with the enterprise system.

- **One NASA** - As indicated above, the CAIB report called attention to the necessity of inter-center communication and collaboration. This has led to the “One NASA” initiative where the NASA is looking to break down the silos and collaborate and communicate across all centers more effectively. Rather than competition between strong centers for funding from headquarters (as was traditionally the case), One NASA was a program intended to drive cooperation across projects where the strongest capabilities of the Agency were brought to bear on problems. One NASA emphasized the role of Strategic Enterprises (the horizontal portion of the matrix in Figure 5) in controlling the activities of the agency rather than the Centers. Although at first One NASA appeared to exist in parallel to the integrated financial management system, the two programs occurred simultaneously and were often associated with each other – many informants treated the two synonymously.

- **Full Cost** - Employed through the implementation of the agency-wide enterprise resource planning system, the purpose of Full Cost was to provide complete and accurate cost information to decision-makers using principles of activity-based cost accounting. Full Cost was intended to ensure that all cost elements in NASA are associated with particular projects, service pools, or administrative overhead accounts. For example, before Full Cost, civil servant salary and certain elements of the Agency’s infrastructure, such as facilities and human resources functions, were funded outside of projects. In the Full Cost approach, all organizational costs

\(^{13}\) Although upper management of NASA has traditionally been picked from the ranks of the scientific community, President Bush appointed Sean O’Keefe, a self-described “bean counter” as head of NASA in 2000 – the first non-technical head of the Agency since the early 1960s, who was Administrator during the time of the initial phase of this study. Mike Griffin, a scientist who spent the bulk of his career in NASA replaced O’Keefe in 2005.
including civil servant salary were to be directly or indirectly charged to projects. This means that time and resources were directly allocated to specific enterprises and in turn to their programs and projects. Anything not billed directly to enterprises through programs and projects was billed to an overhead account, or general and administrative (G&A). These overhead expenses were then distributed over the strategic enterprises by allocating center costs proportionally. By enforcing these procedures, the Full Cost program, as operationalized through the ERP system, was expected to be a key factor in providing the appropriate accountability and visibility necessary for Congressional control of the Agency. Also, Full Cost was intended to ensure fairness in internal resource distribution through standardized time and budget reporting.

- **Ten Healthy Centers** - In the second phase of the study, a new administrator had taken the reigns and de-emphasized One NASA, and instead focused on a new “Ten Healthy Centers” initiative. The Full Cost initiative, as implemented, had a number of unforeseen side effects. Due to initially inflated overhead General & Administrative (G&A) accounts for smaller, research centers such as Glenn, Dryden, and Ames, the research activities conducted by these centers appeared relatively more expensive to the larger centers who tended to control the big programs. This put such centers at a cost disadvantage when competing for business with the big centers or with outside contractors. Because smaller centers were more expensive, overhead accounts bloated, and they became even more expensive, as this overhead was rolled into the cost of doing business with that center. This vicious cost cycle continued for two years, and by early 2006, centers like Glenn were in serious financial trouble and the costs of working with them were prohibitive. Yet, resources were flowing out of NASA to contractors who could perform certain tasks at lower costs. By 2006 Griffin rolled out his idea of Ten Healthy Centers which implicitly assumed the existence of One NASA, and eliminated Full Cost as it was previously operationalized. Instead of competing with each other, Griffin moved the ownership and related funding of important programs within enterprises to the smaller centers (for example, Glenn received ownership of the propulsion for the launch system of the space shuttle replacement – which some say saved the center). Further, the more powerful centers were required to first look within NASA before outsourcing activity.

- **Programmatic Budgeting** – To enable Griffin’s goal of Ten Healthy Centers, he took all funding and programatized it, with the help of the enterprise system. Every dollar spent had to be assigned to a program. A G&A overhead account, and therefore Full Cost, no longer existed. In its place was a Center Management and Operations (CM&O) account that was run like a program and had an annual budget, and the charges this account could bear were limited just like any other program. Headquarters determined the amounts for each program (including CM&O) for each Enterprise or Center, and it was up to the Enterprise or Center to figure out how to spend it.

It is important to contextualize our analysis in these four changes because the integration and control capabilities of the enterprise system are woven into the requirements of each
of these initiatives, yet the impacts of the enterprise system implementation cannot be considered only impacts from implementing a system, but from implementing a system in this dynamic, change-initiative-charged environment.

**NASA’s Structure**

NASA was established in 1958 with the passage of National Aeronautics and Space Act. From the beginning, separate centers were established in order to meet unique challenges of fulfilling the mission of the Agency. Over time, each center has established its own unique competencies, culture, organizational structure, and technical infrastructures. This has resulted in “stove-piped” information systems, organizational processes, accounting standards, and cultures at each center and for the wide array of functional groups within each center. Each functional area built systems in order to meet their idiosyncratic needs, without regard to compatibility with other locations. Also, similar capabilities and knowledge resources were established in different centers, resulting in redundant investment.

Beyond the ten centers, NASA had seven “Strategic Enterprises” that cut across individual centers (at the time of data collection). These are programs such as space exploration and aeronautics research that are funded from NASA headquarters and use resources across multiple centers. NASA’s management structure, with dual layers of centers and enterprises, is mirrored in the way each center is organized with program and project offices in addition to performing organizations. Figure 4 presents a stylized description of NASA’s organizational structure.
Performing organizations provide engineering, scientific, and technical capabilities within centers, but centers also provide other services described within NASA as “institutional functions” such as accounting, physical assets, and information technology. Examples of performing organizations at Glenn (the Center in Cleveland, Ohio) include the Space Flight, Safety and Mission Assurance, and Research and Technology directorates, among others. Within each of these broad organizations are specialized “offices,” for example, within the Space Flight Directorate (which focuses on propulsion technology for space vehicles) there is the Advanced Flight Office, the Launch Systems Office, etc. These offices often have subgroups that specialize further. Program and project managers within the strategic enterprises coordinate and fund the activity of performing organizations across centers to fulfill the missions of those enterprises. On
top of this complex structure, NASA has always encouraged competition among centers in order to produce the best possible outcomes. Centers compete for the program funds with independent proposals.

NASA is also an organization within the wider organization of the U.S. Federal Government and has recently been subject to pressure and scrutiny from other branches of the U.S. government. The tragedies associated with the Columbia and Challenger space shuttle crashes have led to probes into NASA’s organizational practices. Resulting from these investigations, a lack of communication and collaboration has been recognized as an organizational problem within NASA\textsuperscript{14}. For example, the findings in the Columbia Accident Investigation Board (CAIB) report\textsuperscript{15} reinforced the necessity of inter-center communication and collaboration.

The Executive branch of the U.S. Government has also been focusing on greater accountability and efficiency from its Agencies with initiatives such as Clinton-Gore’s “Reinventing Government” and Bush’s “Presidential Management Agenda.” In addition, there have been a series of regulatory and statutory requirements that NASA needs to meet in financial management. These include the Chief Financial Officer’s Act of 1990, the Federal Financial Management Improvement Act of 1996, and OMB Circular A-127 that requires a single integrated system for financial management. In the past two decades, NASA has failed twice in attempting the implementation an integrated financial management system across the Agency.

\textsuperscript{14} For academic analysis of these tragedies and related insight into the NASA organization, see Starbuck & Farjoun 2005.

\textsuperscript{15} As a U.S. government agency, a great deal of documentation on NASA is available in the public domain. This report is available at: http://www.nasa.gov/columbia/home/CAIB_Vol1.html.
In 2000, NASA announced a third attempt at integrated financial management. The new program espoused a number of goals, which have survived virtually unchanged over the subsequent eight years.\textsuperscript{16} The first two goals are especially important, as they explicitly articulate the two key drivers of an enterprise system implementation, and the additional three points flow from the first two. The first goal emphasizes integration:

\begin{quote}
\textit{Provide timely, consistent, and reliable information for management decisions} – Implement standard systems and processes, data integration, and a single point of data entry which will eliminate reconciliation and provide every management level with consistent data for financial and program decision making. IEMP will also provide analysis and reporting tools to get the right information to the right people at the right level so that they can make timely, informed decisions.” \end{quote}

Thus, integration in the form of a single point of data entry, elimination of redundant activity, and immediate data accessibility are keys to the information-related goals of the system. While these are not altogether unrelated to the goals in the second point, this second point emphasizes accountability, management, and control:

\begin{quote}
\textit{Improve NASA's accountability and enable full cost management} - Implement full cost accounting resulting in increased accountability by providing the means to understand cost drivers, determine total program costs, and relate costs to value. This will allow the Agency to manage programs using full cost management techniques and enhance the ability to manage institutional capabilities.” \end{quote}

Thus, the enterprise system’s primary goals involve the integration of key activities through a single system that at everybody’s fingertips and the control born of both greater the visibility this integration entails.

\textsuperscript{16} See: \url{http://ifmp.nasa.gov/basics.htm}, note that although the goals have not changed, the name has. The program is now named IEMP for “integrated enterprise management.”
Next we present our analysis of five activities across two different business processes that offer insight into loose coupling and the three forms of integration (data, process, structure) and two forms of control (bureaucratic, disciplinary) identified above (see Table 2). Before discussing our findings we present a brief analysis of the overall success of the enterprise system implementation at the time of the research.

<table>
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<th>Integration / Control Dimension</th>
<th>Loosely Coupled Activity</th>
<th>Business Process</th>
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<tr>
<td>Process Integration</td>
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**Researcher Purchasing Process**

Throughout the course of their professional efforts, researchers\(^\text{17}\) often needed to purchase a variety of items to support their work – everything from supplies and computer hardware and software to machines and lab equipment to external contracts for research activities from universities and private companies. Before the implementation

\(^{17}\) Here we use the term “researcher” for simplicity to describe the variety of scientists, researchers, engineers, and technicians that engage directly in R&D activity. Many of these individuals have team leadership or administrative responsibilities, but we reserve the term “research manager” for those managers in performing organizations who supervise research personnel.
of the enterprise system, researchers submitted paper purchase request forms to clerical staff, who in turn managed purchasing activity through the legacy system.

Two NASA centers, Glenn Research Center and Marshall Space Center, went live in October 2003 with the core financial components of the enterprise system. These components included the budgeting, procurement, and cost accounting functions (among others). From that point forward, researchers were mandated to conduct purchasing activities through the enterprise system. Thus the ERP system was expected to maintain a single point of data capture at its source (i.e., process integration), and integrate activities from this point through a standard, centralized procurement data repository that would support ordering, delivery, and payment activities (i.e., data integration). All researchers went to training on the system, and a few underwent additional training to become “super users” intended to assist their peers as need be.

In addition, by requiring all purchasing activity to be conducted through the system, there was a sense that management can better control the purchases of researchers (i.e., bureaucratic control). Project managers\(^{18}\) could have more control over the use of their budgets; the agency could standardize the purchases of many items, such as personal computers, which are highly regulated and limited; and there is an effort to formalize and rationalize the sourcing process to enable all potential vendors to bid on any applicable purchases, which is part of an effort to lower overall costs relating to procurement activity.

\(^{18}\) A variety of managers in the strategic enterprises are responsible for financial and technical aspects of programs and projects at various levels. For the sake of simplicity, we will refer to all professionals in the strategic enterprises at the center level as “project managers,” keeping in mind this designation can mean a variety of things.
In the immediate wake of the go-live, we identified three situations of loose coupling across the ostensive, performative, and material aspects of the researcher purchasing process that directly related to notions of integration and control at a level of local practice: (1) the procurement header field (data integration); (2) mediated purchasing activity (process integration); (3) purchasing approval (bureaucratic control). While the loose coupling was evident in each of the situation, the practices were not uniform across the entire organization, so we focus primarily on those instances of loosely coupled activity to gain insight into the implications of loose coupling, while keeping in mind that different groups and individuals vary in their ERP-related activity across the organization.

**Data Integration & the Procurement Header Field**

Before implementation, the purchasing module was customized for government application – and was significantly expanded beyond the “vanilla” scope of the default settings:

“In government procurement you need so many little pieces of data for everybody that I think we maxed out our fields . . . I mean it’s a different system . . . There’s a lot you have to put in any government requisition or a PO - there’s a lot that the buyer needs and a lot that has to be reported somewhere or captured somewhere, so we have our own tab - the NASA data tab - and that’s maxed out . . . the number of fields that are used in it with SAP’s functionality now.” (Service Checker B, interview transcript 2-23-04)

Informants indicated that even with the extensive customization, some of the required functionality was missing. Since, as the procurement specialist above indicated, the NASA tab was “maxed out,” rather than reconfigure the system, certain data that could not be placed elsewhere was expected to be included in the generic “header” field of the
system. These header requirements were part of the official system implementation that researchers were trained on. The use of the header in place of fields in the NASA tab was coded as ostensive-material (O-M) loose coupling, as the material properties of the system as implemented, through the appropriation of the header, was not aligned with the initial expectations whereby data necessary for purchasing activity was housed in appropriate fields in the system.

Throughout 2004 and 2005 (T2-T3), the “standard” information contained in the header field was essentially a short-term workaround due to the limitations of the initial implementation. However, the Glenn / Marshall implementation was becoming spread through NASA as other Centers were coming on-line. Therefore, the informal workaround of the standard header information was becoming a formal part of the process. Thus we find that the ostensive aspect of the process in the form of initial expectations for integration and control, and the new ostensive aspect, which allows for the improvisational use of the header, represent ostensive-ostensive (O-O’) loose coupling over time.

Further, the amount of information to be contained within the header was growing – as one implementation manager indicated, it was partially due to the “super user” administrative people that were mediating the system use for the researchers:

*It turned out that it is quite challenging for many people and so only the super users, it turns out, my observation is that becoming regular users and people, infrequent buyers seem to ask the super users to process most of their request. And as a result there is the design of the PR form in SAP to not capture actual requestor’s name and the information and delivery and so in order to accommodate this change, if you will, unanticipated change, you began using header more extensively. Header seems to capture, to me like when I first heard about header I thought header is like a footnote and some kind of additional information, but lot of critical information actually is*
being captured in free text form in header. (Implementation Program Manager A, interview transcript 4-1-04)

In addition to adding the requestor’s name, other data – sometimes data that was supposed to be captured within fields of the customized menus – was being added to the header. For example, under the “vendor” tab of the purchase requisition has a number of fields for vendor information. Rather than use that tab, much of the vendor information became part of the header.

So if they’ve already talked to a company, maybe they’ve even gotten a proposal, you know, if we’re going to call the company up, we want to talk to that same person, so we need any information they have, Procurement needs, or else we’re just doing it all over again, takes twice as long. So we ask them to put all that information in the header. Now, I think in the past we had asked them to do it as an attachment, or there must have been someplace in there where you could put some kind of information. – (Service Checker A, interview transcript 2-19-04)

This service checker’s remarks not only indicate the expansion of the header, but also indicates that there’s a relationship between the growth of the header and the intermediation of what she calls “super users” that mediate researcher purchasing. Therefore, while the O-M loose coupling identified in T1 was still evident, with the data either redundant in the header, or replacing data intended to go in other fields, we discover a situation where the material properties of the enterprise system are, in a way, loosely coupled to themselves – or what we can describe as material-material (M-M’) loose coupling.

In the researcher purchasing process, the first situation of loose coupling involved the header in the researcher purchasing process (see Figure 6). Upon go-live (T1), the implementation team discovered that the functionality of the system (M), that is, the fields within the purchase requisition tabs did not fully satisfy the ostensive requirements
(O) of the purchase requisitioning process. Thus the header was improvisationally used for some of this data, indicating that the material aspects of the process were loosely coupled to the ostensive. By T2, the use of the header became formalized, thus the new ostensive process (O’) became removed from the old ostensive process (O), indicating that although performative, material, and ostensive aspects were now aligned, they were aligned with less integration than was originally expected. Thus we find another interesting form of loose coupling – the ostensive practice to itself over time (O-O). In T3, as more data was incorporated in the header, the system moved further away from the promise of complete integration, it became institutionalized throughout the Agency as the Glenn-Marshall implementation rolled out. By T4, the change was fully formalized and users depended more and more on the header – to the point where the header now included information that was supposed to be in the fields of the purchase requisition tab.

Figure 6. System Functionality (Header) and Loose Coupling in Researcher Purchasing
The formalization of information in the header *instead* of within the relevant fields, undermined, to some extent, the integration associated with enterprise systems, as data is now in a generic, singular, field rather than within the data structure associated with the system. This example represents a decoupling of the original material aspect of the practice (M – header used for data not in the fields) with the new header-focused aspect of practice (M’ – header used as purchase requisition). The system became loosely coupled from itself! Although ostensive, material and performative aspects of the practice were in alignment by T3, and therefore not loosely coupled, the new ostensive process was less integrated than the old ostensive process. In this situation we find another new form of loose coupling: the ostensive aspects of the ongoing system-in-practice (formalized use of the header) vs. the ostensive aspects of the system-at-implementation (fully integrated use of fields in the tab). This analysis of the procurement form’s header functionality also touched upon the tendency for researchers to mediate their system use, which we will address next.

**Process Integration - Mediated Purchasing Activity**

Initially, researchers unanimously indicated that the system was not very user friendly, and generally reported working through administrative people for purchases rather than interface directly with the system. In one case, a researcher who initially signed up as a “super-user” and was first to be trained, indicated that he later fully mediated his system use through an administrative person:
We have an executive assistant to the division chief who is primarily responsible for imputing procurement requests... researchers can do it and some of them do... it takes more [of a researcher’s time] time to work that system and to work issues associated with that system. It takes away from their ability to actually do research. (Researcher B, transcript 2-11-04)

The issue was not the abilities of the individuals – as researchers are highly technical people who often interface with extremely complex systems. The “super-user” mentioned above did not avoid the system based on inability, but rather, time consumption. Procurement simply took away from his time doing research. Other researchers expressed an element of disdain for work that was not contributing to research goals. One researcher put it rather clearly when he indicated that researchers are “buying toilet paper... literally... that are high paid people” (Researcher C, transcript 2-17-04).19

We coded mediated system usage as material-performative (M-P) loose coupling, as the actual purchasing activity was not conducted directly on the system, but instead mediated through an administrator.

As indicated above, the mediation of researcher system use was widely becoming acknowledged and was being accepted. Within months of go-live (T2), the implementation team began offering a “requisitioner refresher course” targeted specifically to the people doing the requisitions. During these courses they offered a document known as the “PR Checklist” through which they specified the role of the requisitioner, process steps, and information required for the header.

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19 It is important to keep in mind that in certain situations researchers did report direct use of the system to do their own purchasing, much the way that the implementers of the ERP system intended.
When the SAP system was first implemented because like I said, our, I was trained, you know, as the clerical support to know it so when it’s implemented all the engineers, you know, can come to me for help ... Power requisitioner is that they called it I think when it was like being implemented. Like they selected a handful of people to be trained first, and then now we’re just all requisitioners, I think. (Administrative Division Support A, interview transcript, 2-11-04)

By referring to mediators as simply “requisitioners” the implementation team was quickly establishing some permanence to the role that enabled mediated researcher purchasing. Because of the formal acceptance of mediated use, the ostensive aspect of the practice has changed. Instead of the initial expectations for integration through a single point of data capture and universal use of the system, and the new ostensive aspect, which allows for the mediated use, represent ostensive-ostensive (O-O’) loose coupling over time. The (P-O) loose coupling was essentially supplanted by the (O-O’) loose coupling.

However, mediation in the point of purchase requisition was not the only point where the process was now mediated. After the initial implementation, there was a specific help desk associated with procurement in NASA Glenn. The group within this help desk assisted with requisitioner training and answering questions for buyers, project managers, and the researchers involved with procurement. The system itself was intended to verify proper that all relevant fields were filled out and actions were completed, then the system would route to the appropriate buyer, purchasing agent, or logistician in the procurement office. However, this process was rife with delays. Because of the increased content of the header, the logic of the system routing was not always accurate and orders would “sit” in procurement – often for weeks. Further, there were often problems with purchase requisitions such as incomplete, misplaced, or incorrect data that necessitated additional
action on the part of the requisitioner. Therefore, the procurement help desk staff became
renamed “service checkers” and their temporary positions became permanent:

“As a service checker, I look at it as it’s more of a responsibility. We’re responsible
for making sure that those requisitions are in correctly... there’s three volumes, as
thick as a phone book, of regulations they need to follow each and every time... so
now we’re able to kind of shepherd that process along. Yeah, we’re demanding a
little more stringent look... in all fairness they’re probably stressed out by learning a
new system as well. They don’t need to be arguing about, “You don’t have a
statement of work there for me to work on. How am I going to - I don’t even know
what you’re buying.” That should be settled up front. We’re now settling it up front.
So your package is in order and it has to go on and they would buy it.” (Service
Checker B, interview transcript, 4-22-04).

U.S. Government regulations are particularly stringent in pressuring agencies to
rationalize their sourcing process – allowing a variety of vendors to compete for
government business, thus ensuring a low price and spreading government spending. If
researchers required a specific vendor for a purchase, they were required to provide “sole
source” documentation justifying this decision. The service checkers verified that sole
source documentation was included and complete, or purchases would be sent out for bid.
In addition to ensuring all of the steps and data are clean, service checkers were also used
to verify a new point of control known as the RPM approval. Thus service checkers
added a second level of mediation in the researcher purchasing activity, although this
time it is not mediation between the performative and the material, but rather, the
material and the ostensive (O-M) requirements for integration.

Four years later (T5), our analysis shows that researchers continue to avoid use of the
system in general, but now such researcher avoidance has become standard practice. By
all reports, the practices associated with the researcher purchase process have stabilized
in recent years, but the information can change change slightly each year:
It changes a little bit every year. We’re required to take a PR refresher course every year to keep that role in SAP... Different justifications that they might need, funding approvals change, how it gets routed changes, the SAP software gets updated sometimes or the fields will look a little different. (Administrative Division Support A, transcript 2-6-08)

There are a limited number of people who are certified as “requisitioners” (typically clerical staff or technicians) and these requisitioners must go through annual training, where they receive new checklists that guide their actions, including their use of the header. In this situation, the arrangement seemed to stabilize in a semi-permanent state of loosely coupled equilibrium (see Figure 7).

Figure 7. Researcher System-Use Mediation
To this point our analysis has focused on the way data was not tightly coupled as anticipated, due to the header-related activity, and activities within the process were not integrated to the point originally anticipated – and were now enabled through multiple points of process mediation – the requisitioners and service checkers. Integration-related outcomes was but one aspect of the system goals, as the ERP system was also intended to aid in controlling certain aspects of the process. Following we will present our analysis of bureaucratic control-related issues in the Researcher Purchasing process.

**Bureaucratic Control - Purchasing Approval Activity**

An important aspect of the original implementation – an aspect that was met with incredulity from many of our informants – was that purchases did not require an approval
process in the system: “I find this hard to believe, but there’s no way within IFM to set up a pre-approval routing process.” (Project Manager F, interview transcript 2-17-04)

Therefore, researchers could theoretically order things without direct approval and commit the budgets of project managers. The inability to approve in the system was described as a “fallacy” and the IFM team intended to resolve it in a future release:

> And yes, that is a known fallacy. That’s not a deficiency in the system. But it was something that SAP at the time we delivered it wasn’t going to change it because they said it’s part of their enterprise upgrade and it was going to be covered there. So I believe that routing, and that is an issue and we understand that. (Implementation Program Manager A, interview transcript 4-1-04)

We coded the absence of real-time approval as performative-ostensive (P-O) loose coupling, as the system did not provide the real-time control, which was an original goal of the implementation, but did enable retrospective auditing of purchases.

The project management office was frustrated by the lack of proactive control over their budgets, as anyone could theoretically commit the funds they were supposed to manager. Thus project managers were auditing expenditures after the fact rather than controlling them in time:

> “The researchers themselves, you know, they have a plan, they’re working to the plan, they’ll keep spending their money until somebody puts a hold on it, you know, and so, I mean, it was, I worked on a small committee here at the Center that tried to raise that before IFM was implemented. That there were no controls to prevent people from putting a PR in the system. And our understanding is that once the PR was in the system, the money was committed... We have no control in the finance system... The project is responsible for the budget. We have to tell how the money’s spent. We used to be able to, you know, control who spent the money. Now, we’re in audit fashion. We go back and we find out who spent the money.” (Project Manager C, interview transcript 2-12-04)

To address this situation (T2), the project management organization, together with procurement management at NASA Glenn, created a web-based RPM form that is
informally routed to appropriate people in the project management organization who control funds:

“Basically if somebody wants to spend money, they fill out this form called an “RPM Form” and they email it to my office and say, “Before I even initiate this requisition in IFM, here’s what I want to do.”... it’s kind of a pre-certification, but it’s separate from SAP and IFM; no other center to my knowledge does it; but it was a result of the project managers complaining about what I was just telling you about...other people spending project money without our knowledge.” (Project Manager F, interview transcript 2-17-04)

The RPM system was not immediately adopted throughout the Center, as some project managers did not want to control every item, and certain managers in the performing organization resisted. However, this resistance was largely overcome through the insistence of the project management group and through formalizing the requirement of an RPM number through the header, enforced by the service checkers. The narrative of one project manager shows that the RPM process was rife with conflict – in her own organization, and with performing organizations, accounting functions, and the enterprise system implementation team:

And that was a trust thing, I mean, I sent out emails to my whole team and said, “I know there are varying opinions on whether we should use RPM and I know your management has opinions but you are using this project’s money and you will put an RPM in for everything and when I read the reports, if I don’t have an RPM I will come looking for you, basically. I mean, it was a subtle form of threat, but we’re trying to do some big cultural changes here and at the end of the day I’m the one who has to stand up for this project. And so I thought the RPM process was very successful. We got a lot of grief from [the implementation team, who’s manager] was not very happy that we did this at all. Again, there was a ‘we’ versus ‘they’ setup and I don’t know why that ever occurred. Again, I’m not privy to a lot of the meetings that occurred but we should’ve all been working this collectively because if we only have one database where all the data is, it has to be there for everyone’s benefit not just the accountants. So the RPM’s as much as they fought it here, again, through the grassroots, no problem, it worked and we’re still using it.” (Project Manager A, interview transcript 2-19-04)
In adding an entirely separate system, project managers increase their control but do so to the detriment of complete integration. As indicated in the interview with Project Manager A above, the RPM system was contentious. While it made a great deal of sense from the perspectives of project managers who wanted proactive control over spending on their projects, it simply did not make sense from a single, integrated system standpoint. As a powerful implementation manager indicated in 2004:

“There are some basic fundamental decisions that were made about the level of detail and which funds control would take place, and the way that we would manage the fact that funds control would take place at that higher level, when in the past it had taken place at a much lower level, so that was where we were going in. And so instead of adopting to the agreed to approach of how that would work, we’ve actually created a system to allow us to continue to do funds control at a lower level... see, the program and project managers, they don’t, we haven’t communicated well that decision that was made. And they’re not aware perhaps of that. They may even disagree with it - they may be aware, but disagree with it.”(Implementation Manager B, interview transcript 4-22-04)

As NASA moved toward management of funding through the strategic enterprises (T3), managers in neither the performing organizations nor the project management had proactive approval. In line with a single-point of data entry, researchers were empowered to make purchases directly into the system, assuming there was funding allocated. The implied rationale is that if projects were planned properly up-front, there is no need for such approvals in the eyes of the new process. As a research manager indicates, in doing away with RPM, he now has no control whatsoever on the project-related purchases of the people in his organization:

“They said they didn’t like having two systems, so they just eliminated the system... It was up for a couple of years after IEMP came on and said it wasn’t working. I don’t know if it was at headquarters or at Glenn ... They eliminated that because they said it was another system and it wasn’t controlled. It didn’t meet the ISO9000. So you went back to no control again... we’ve lost the ability to control the resources. The project got more control. The people that are spending it and those in charge of the people...
that are spending it have less control… I’m saying put the control closest to where the work’s being done. If he spends my budget or I spend his, we don’t know because the project only looks at project.” (Research Manager D, interview transcript 2-4-08)

The distinction between a manager from a performing organization and the project manager’s view is important. Project managers look at the total expenditures relating to their projects over periods of time. Typically researchers are involved in a number of tasks for a given project, and these tasks represent a finer level of granularity. In the past, performing organization managers received the funding and rationed it out among researchers. This new method essentially circumvents the research manager by aggregating many of these tasks together in a project.

From a control perspective (Figure 9) the use of an RPM system in T2 more fully aligns with the real-time control principles associated with the enterprise system implementation. From an integration standpoint, however (Figure 10), the use of the RPM system in T2 represents an instance of loose coupling – in that the parallel system is not a single point of data capture and is only linked to the enterprise system through the actions of the researchers or their intermediaries. In this example it appears that tighter coupling of control with practice is inversely related to the tighter integration associated with the promise of the enterprise system.
Another area loose coupling remains is through a time lag between the project manager’s awareness of a procurement and the commitment of the dollars. Project managers analyze reports at the end of a given time period to see which procurements were made. If there are purchases that they do not understand, they can sometimes get the purchaser to back them out of the system, or they have to apply a penalty to adjust the respective
account in the following period. Thus the control is not proactive or complete, and there is a time lag between the activities indicating incomplete integration. However, there is some control and attachment to the budget which shows that there is some responsiveness, but it is incomplete, or loosely coupled. One project manager indicated that this was not “management,” but something else:

*My personal perspective is we may be giving ourselves a false sense of management. In other words, we’re watching the data and thinking we’re in control. But we’re seeing the data change and being reactive instead of proactive. We’ve probably decreased the amount of active project management because we’re watching data instead of managing the project. (Project Manager E, interview transcript 2-26-04)*

Although this control was reactive, there was still project level control over researcher purchases. Further, the system did disallow certain forms of purchases (e.g. computer equipment) and required certain activity (e.g. multiple bids). Thus to avoid certain forms of control associated with purchasing through the system, some researchers circumvented the official procurement portion of the system entirely – using credit cards known as “P-cards” to purchase items and thus following a different, less labor-intensive procedure that enabled researchers to purchase whatever products from whichever vendors they choose. However, P-cards had spending limits of $3000 per purchase, but some researchers split up their orders in multiple sub-$3000 increments rather than go through the procurement system. In certain situations P-card use was either inappropriate or limited by management, in which case the formal purchasing process –either direct or mediated through an administrator – was required. We coded circumvention as loose coupling between the performative and ostensive (P-O) aspects of the practice, as the formal purchasing activity was circumvented.
Since researchers were using P-Cards in creative ways to avoid the spending limits and to buy products that were off limits such as computers, service checkers were inserted into the P-Card process in T2, and their methods for control adapted over time to address the new, novel ways that researchers used P-Cards to circumvent formal process control. While the service checkers enabled greater, proactive control, this control was still not completely in-line with ostensive aspects of control as implemented by the system. As service checkers learned, this control was increased, but was never perfect. There was always room for researchers to engage in a bit of manipulation, such as the way they used P-Card purchases to avoid sole source limits. Therefore, we identify what appears to be a process of mutual adaptation resulting in, what for now may be a fairly stable equilibrium.

![Figure 11. Control in the P-Card Process](image)

As we compare the ratcheted increase in control over the P-Card process, we do not see a relationship between this increased control and integration over time (see Figure 8 in the...
“data integration” section above). With the insertion of the service checkers (T2), we see less integration, but this level of integration remains stable over the life of the study. While initially it appears that integration and control may be inversely related when the new control mechanism (service checker) is applied, over time as control is effectively increased there is no corresponding movement in integration, indicating an element of orthogonality.

The tracking and control purchases is but one of the areas of researcher activity that project managers are expected to control. Funds for the performing organizations can be divided into purchasing, travel budgets, and time for researcher time – measured in “full-time equivalents” or “FTEs.” Next we will bring our attention to this overall project tracking level of analysis, of which the purchasing activity is a part, to understand loose coupling in this domain.

**Project Tracking Process**

Strategic enterprises are managed from NASA headquarters, and award Centers the lead role on specific programs within enterprises. The programs, in turn, award several projects – often to the host center, but also to other centers, outside contractors, and universities. These projects, in turn, have further subprojects and specific tasks. For example, NASA’s Space Operations Mission Directorate includes the Space Station and Shuttle Programs. Within the Shuttle Program, the Constellation Program is charged with the development of the Orion & Ares Crew Exploration Vehicles (replacement for the existing space shuttle), which includes projects for the service module, crew module,
space craft, and launch abort system, each of which have a number of subprojects. Johnson Space Center is the lead for the overall Orion program, but the Glenn Research Center has overall responsibility for the service module project, whose work is spread across NASA centers and outside contractors such as Lockheed Martin. Therefore, although project managers work out of specific centers, they are often charged with managing distributed projects. A project manager captured their reporting situation:

_We serve two masters... Well, my personal paycheck comes through the center... But the funding that comes into the center... comes from our customers who are at other centers or NASA headquarters. Programmatically, I report up through a programmatic chain with my customers, which at my case are at the Marshall Space Flight Center. The project budget that I manage is determined by them; it’s provided by them; I report to them. At the same time, I have to give very similar reports to my line management because the center’s interested in the programs and projects that have been assigned to our center. They want to know how much income is coming in and if we are being successful or if we’re delivering. It’s a duel reporting situation. You have line management and you have the programs and the project customer._

(Project Manager F, interview transcript 2-4-08)

NASA management indicated that the project management organization should use the ERP system to manage project information. The system was expected ensure integrated access to project and budget information which would inform project management organizations in real-time, and to enable them to manage resources across the Agency. In this sense, the integration associated with project managers directly using the single database of the system was intended to improve data visibility which would enable project managers to control projects more thoroughly.

The two mechanisms which directly impacted project management tasks were integrated budgeting and the “Full Cost” management functionality. Integrated budgeting allowed project managers to see, real time, when they have funds, reallocate them as necessary, and see where their funds are going. Some of this financial information hinged upon
activity-based time reporting in the ERP system. In the wake of the system implementation, all hours of research, engineering, and service pool time must be billed either to a specific program or to a catch-all G&A (General & Administrative) account for each center\textsuperscript{20}. While many of the benefits associated with the integrated financial management system were dependent on the tight coupling of project management to the system, the tracking of researcher time is an attempt to more tightly couple their activity to the specific projects and programs and in this way control individuals and their activities (i.e., disciplinary control).

In the years following the system implementation, disruptive events swept the agency. While some large centers like Marshall noticed relatively little change, smaller centers – especially research centers like Glenn – were disturbed dramatically. The new ambitious missions of the shuttle, moon, and Mars did not bring additional money (the overall NASA budget from 2002-2007 was flat, hovering around $16 billion per year), and NASA management needed to make a large number of resource allocation decisions. During this time, NASA began to move its resources from “pure” research associated with Aeronautics, and to a lesser degree, Space Science, to the Space Program, which makes and launches vehicles and involves more applied research and engineering activity. Since the greatest amount of funding for NASA Glenn came from Aeronautics, Glenn was facing a great deal of funding contraction.\textsuperscript{21} Further, as a way to manage budgets in line with the space exploration mission, the strategic enterprises were given more authority

\textsuperscript{20} The G&A account also consisted of a number of sub-accounts such as “training” and “travel” which, for the sake of simplicity we will refer to as G&A.

over budgets, and funds available for center overhead were dramatically reduced. Researchers, however, were finding fewer places to bill their time and overhead accounts were bloating. The center had less of a budget for its hierarchy to load balance internally, and therefore attempted to sweep costs into projects – which made Glenn appear to be more expensive, thus diminishing the business that did exist.

In early 2006 things looked grim for NASA Glenn. By early 2007, however, the situation had vastly improved. Mike Griffin (NASA Administrator) made a number of key moves. The first was his “Ten Healthy Centers” initiative, where he decided that the smaller centers were becoming weak, while some of the larger centers were outsourcing to industry. He thought that it was important to utilize NASA’s capacity and give preference to keeping work in-house. In the words of a project manager:

‘One NASA’ is looking for the best place to get the work done. ‘Ten Healthy Centers’ is looking for the best place to get the work done and making sure that if there are two places to get the work done and somebody’s got a full plate in one, you go to the other one who may need more work... O’Keefe to Griffin it was contract out versus the expertise within. (Project Manager E, transcript 2-11-08)

He also gave Glenn ownership of the service module for the new exploration vehicle – a large project in the lucrative “Constellation” program. Further, Griffin eliminated Full Cost accounting, and instead went to strictly programmatic budgeting. He took the most recent overhead numbers, froze them, and projectized them – now referred to as Center Management and Operations (CM&O) program. Now people must be funded either by projects or by CM&O. This incentivizes cross center collaboration as headquarters is essentially subsidizing the institutional overhead associated with bringing FTEs into a NASA project.
Further, a new, highly respected center administrator heads NASA Glenn, and many of our informants indicated that he was instrumental in bringing new project funding to Glenn. Many service pools have been eliminated, the workforce has been reduced, and the bulk of researchers have made the shift to (at least a portion) of Space Mission projects in replacement of, or in addition to Aeronautics work. At this point, we found two broad areas of loose coupling in the project tracking process: researcher time tracking (disciplinary control) and project funds allocation (structural integration).

**Structural Integration – Budget Management**

Through the ERP system as a central, standardized repository of all of NASA’s budget data, the ERP system promised to integrate flows of financial data across previously siloed Centers and performing organizations. The ERP system enables the management and viewing of fixed budgets, fixed calendar-based time frames, and tracks expenses when recognized rather than accrued. Research and engineering progress and accompanying expenses and time tracking, on the other hand, are difficult to predict and rife with variance. Thus, in the NASA data budget management serves as an example for how the global, or centralized, database does not serve the local practices for all applications.

Project managers often identified themselves with managing variance. As they attempt to manage and track scientific and engineering projects, budgets exist, but the timing of activity, magnitude of expenditures, and project outcomes all vary – and project managers pride themselves on accurately gauging and communicating this variance. One
project manager was quite adamant about the inappropriateness of the ERP system for her job due to project variance:

*It’s described as an accounting tool, a ledger... That means absolutely nothing to a project manager like myself who is tracking plans versus actuals. What are my variances? Who blew my budget? Who’s overrunning? Who’s under running? To me a ledger was not going to help me very much with that.* (Project Manager A, interview transcript 2-9)

In addition to this observation, many project managers were upset that their perspective was not reflected in the system, and that the implementation team made no effort to solicit their input before go-live, and although the “fluff documents up front say it’s going to help” (Project Manager E, interview transcripts 2-26-04) with a project manager’s job, it apparently did not, in the estimation of any project managers we interviewed:

*And IFMP is a whole other situation also because when that was implemented and it was brought to us, those of us in the project management world realized that this doesn’t help us at all. It actually makes our job even harder, okay. And I started digging and trying to find out what’s going on. Apparently IFMP was designed to meet the needs of the people in the financial organizations, not the project organizations. The project organizations’ input never made it into the final product. They had to make a decision between the needs of the projects and the needs of the financial people and they decided to implement the needs of the financial people.* (Project Manager G, interview transcript 2-4-04)

Based on these perspectives, the project management team initially resisted the system. Emboldened by the two previously failed attempts to implement an enterprise system, upon go-live a significant portion of the Glenn project management organization simply continued to use their existing system, which was not integrated with the enterprise system. Various activities of active resistance were reported, from incidents of project managers walking out of training sessions, to project managers from a variety of organizations coming together to advocate for more project-management-oriented functionality. Thus, through outright non-use of the system, ostensive aspects of project
tracking relating to system use and performative aspects of the project tracking in legacy systems (P-O) was more than just loosely coupled, but rather, decoupled.

In the months after the implementation the implementation team acknowledged that they overlooked the requirements of project managers, and began looking into ways to get project managers the reports they needed. In the meantime, however, they unplugged the legacy project management system, and project managers made do through intermediation and shadow systems. Further, research groups began to recognize that their activities were being more highly scrutinized and attempted to attribute less of their time to the G&A account. This added to the way resources were “load balanced,” in that it was still happening on the center budget level, but also to a degree at the level of individual researchers.

Different project teams dealt differently with the removal of the legacy system, but the stories typically involved a period of time when they struggled with getting data from SAP, then intermediated usage of reports from Business Warehouse, a reporting tool, once the reporting tool came on-line. Following a project manager gives a narrative that was typical in our interviews:

_They killed the system. They turned the systems off. When IFMP came live with SAP and even BW wasn’t live when they cut over, it was SAP or nothing. You had no alternative... It wasn’t until our people that had helped develop the canned reports for the old systems got indoctrinated into the new system and BW and the capability that BW brought with it... It was just an upheaval. They pulled the rug out from everybody and nobody felt comfortable... We had a RAMO person that came on board as we made that transition and she just took all of the finance stuff over which was great for me... (Project Manager C, interview transcript 2-12-04)_

From an integration standpoint, it is important to note that Business Warehouse used a data warehouse to extract data from SAP and run reports. Although financial (RAMO)
analysts could get reports for project teams at any time, Business Warehouse typically ran monthly reports for the projects.

The BW is basically pulled out of this data warehouse, and then these people out in the field use the queries against the BW. We never had that capability before, and so that really did change a lot. And we certainly haven’t solved - haven’t completely transitioned to - the change that’s created when you do something like that... the way the funds control works now, has caused people to feel like they need to have satellite system to manage that process. (Implementation Manager B, interview transcript 4-22-04)

Despite this accommodation, many project managers indicated that they managed projects outside of the system – on “satellite systems” – only to periodically reconcile the data in these outside systems with ERP. This activity is widely prevalent across the project manager community, and the project managers that report this activity often explicitly call out variance as important to guiding their activity:

We’re still, ... using offline systems, planning spreadsheets... we use the Business Warehouse as a data source... extract the data off and still put it in our front end that we give the project managers in their monthly status report. We build a phasing plan at the project level offline from the center-level system. Okay. We extract the actuals off the center-level system and marry it up with our plan offline. And that’s the report the project managers use . . . to status variance. (Project Manager E, interview transcript 2-26)

In the years following go-live, project managers continue to avoid using the system. Business Warehouse provides data and project management organizations rely on administrative or financial people to populate spreadsheets or databases that can re-process the data in-line with their needs. A project support person describes the typical state of project manager mediation:

We have the data downloaded by a couple of guys. They’re both analysts as well as database guys. They download it into Access and it’s on a financial website and this way it’s available for people here at the center... It does need a little bit of cleaning up once it’s out. Ours doesn’t look like the BW reports straight out of BW... So for the
folks around here, we have the data updated. As soon as it closes, they run their standard queries. They have everything all set up in bookmarks and they hit it right away... We have a lot of different projects and different WBS numbers, so we have to download data. We have it downloaded not only to the website but we have spreadsheets it gets downloaded into that generate a lot of our standard monthly reports. So we’re ready to hit it running as soon as BW closes. (Administrative Project Support C, interview transcript 3-14-08).

Different project management groups mediate their access to the data differently, but the human intermediaries and shadow systems are always part of it. The implementation team did generally acknowledge a mistake in not seeking out the perspectives of the project management organizations before the enterprise system implementation, and actively began doing so in the months afterward.

*We’re not using techniques like earned value management effectively, so given earned value management is an integration of budget schedule, actual costs and associated metrics, that we’re going to play into that game - “we” being this program. So there’s a lot of work or planning going on right now to work with that community to see what we can do. So we’re starting to really involve that community today.* (Implementation Manager C, interview transcript 4-7-08)

While acknowledging that the enterprise system is not perfect for project management, the implementation team (in Glenn) were clear that there was no other choice, and they actually argued that, although not specifically made for project management, in many ways it is actually better, due to real-time integrated data:

*Nobody said I’m going to make you a better project manager for CORE finance, I will give you better data and more timely data. You don’t have to wait until, you know, so many days into the month to find out what’s happening. You have immediate access to see okay, I want to obligate this, I have an obligation, I want to get it into the system. You can find out whether or not it’s in, now. You don’t have to wait until it went through eighteen different hands to see where that is. You have more information and more timely information. But you know this, but nobody ever said it was going to be a project management system.* (Implementation Manager A, interview transcript 4-1-04)

The implementation team considered the ERP system as simply a “new” way of managing budgets, and generally seemed to think that project manager adoption was
simply a case of learning the tool, and therefore disconnected the legacy project management (at Glenn, this was not the case at Marshall) and project managers now had no choice but to use the data from the enterprise system. However, the reporting from the enterprise system was very difficult to use and simply did not give the project managers all of the information they wanted. One project manager describes how he was handling the situation:

“I can go in theoretically any day and pull up the data, except that it’s such a cumbersome system that I gave up. I don’t even try to go into the system anymore... The woman that we have who works these kind of things, and I showed her this, I said “This is the kind of data that I need”. So, she’s trying to figure out how to get that. Is there some way she can just get it right out of SAP or is she going to have to; I believe the people who did this [in other project management groups] have actually set up, this comes out of I think Microsoft Access, it’s a database. It’s to actually download the data from here, into the database to create this nice report as opposed to getting a nice report right out of the system. So it’s an extra step, extra labor... What I have told her is I need something that has this kind of data. I need to know the description; I need to know the status of the commitment, ops and costs. I have to have that. I cannot manage tasks if I look at this and I don’t know what that is. It doesn’t help me.” (Project Manager D, interview transcript 2-25-04).

To summarize, project reporting activity was basically decoupled from the enterprise system in T1 and T2. The performative aspect of the process simply continued to use the legacy system in T1, then, by many accounts, simply did not occur – certainly not through the system – in T2, thus the performative aspect was entirely decoupled from the material and ostensive aspects of the practice associated with the system. However, the implementation team and project teams both saw that this state could not continue, so each began working toward data access. The implementation team, rather than modify the system or its expectations, worked with customizing a reporting tool, Business Warehouse, to get the reports that project managers needed in T3. As project managers
no longer wanted to access the system directly, they mediated their access of Business Warehouse through human intermediaries and local systems.

The effect was a situation of loose coupling enabled by three mechanisms simultaneously (see Figure 12). The material functionality of the enterprise system was loosely coupled with the material aspects of functionality of Business Warehouse, which in turn, was loosely coupled to the local Access database or spreadsheets (M-M’-M’’). Although the data were the same, they were not tightly coupled in that the data did not represent real-time integration, but rather were periodically updated. Further, while the ostensive aspect of the practice now involved Business Warehouse (O-O’), the performative aspect of the process was entirely mediated by another individual, as project managers did not access the system directly (P-O). In one sense, the result again indicated a semi-stable state of loosely coupled equilibrium resulting from some mutual adaptation, but this equilibrium was simply not integrated.
Although there is a triply-mediated form of loose coupling evident, many project managers were now enthused about the system – including those same project managers that initially resisted and complained about the need to use ERP for project budgets. ERP-related integration enables unprecedented collaboration between centers through visibility of resources associated with cross-center projects. One project manager reported the ability to move funds between centers in just a couple of clicks, a process that historically would have taken a week or more:

*The project manager here at Glenn was in charge of the whole project and his subproject manager at Langley was running out of funds. They’d say, “I need more money. I can’t finish this task.” Then he got to work with the finance person here at Glenn. [In the past] We’d have to put in a request to Headquarters to actually take money from our guideline, take it back to Headquarters. They’d have to reissue it to...*
Langley. Now, we can just move money between centers. (Project Manager C, transcript 2-15-08)

Further, there is a positive attitude about how the ERP system could help small centers like Glenn to be on equal footing with some of the powerful centers (like Marshall & Johnson). In this context, any inconveniences to the project managers, minor inefficiencies associated with redundant data paled in comparison to some of the broader themes within the agency.

**Disciplinary Control – Project Funds Allocation**

In addition to active resistance on the part of project management, it is important to clarify the initial responses of research groups to the time-tracking portion of the enterprise system. Funding from the projects went to the center accounts, as did a significant amount of funding from headquarters. Researchers were accustomed to tracking time for projects, so they continued to do so, but now using WebTADs, which was an acronym for the time tracking functionality integrated into the enterprise system. Researchers either billed their tasks directly to projects, using the work-breakdown structure (WBS) numbers associated with the projects, or they billed their time to G&A accounts. Therefore much in the way of organizational budgets were reconciled at the center level. Executives generally indicated that they did not use the system, and that they were not necessarily aware of specific details of this activity, but were broadly aware of it:

*The Centers... really kept almost two sets of books. There was one set that we saw as researchers that was the discretionary, the money available for discretionary spending to write contracts, award grants, buy equipment, operate test facilities, buy power for the test facilities. And then there was another set of books which covered our salaries and fringe benefits. And when money came into the Center, a certain*
amount was taken off the top that we never saw to cover the salaries and fringe benefits, and so from our perspective, they said “Well here’s how much money the Center has to work with” and it’s what was left (Research Manager A, interview transcript 2-3-04)

Since the various research programs and associated expenditures occur at an unpredictable pace, yet programs are managed in well-defined milestones, many center managers reportedly kept a separate set of books to manage their budgets, only to reconcile them periodically with the ERP system. For example, one executive allows a staff member to shuffle funds between budgets to enable activity as required while still appearing to be within budget to the system:

*If you’re the head of an office and you’re running low on money, you can come to the Budget Meeting and say “Look, I need this money” and I can say “Well, I know so and so has it and he’s looking for travel money... Each month I reconcile it back. So you can cut deals among each other or I can reallocate money, and my boss has given me pretty much full authority to do what it takes to get it done... So, basically he allows me to go ahead and work the budget so that everybody’s satisfied. “You know, [informant’s name] I’ve got a problem I need $4000 to do XYZ”. ... “Let me see where I can dig it out” ... “I noticed that the contract’s running behind plan, do you mind if I give so and so $4000?” “Sure, go ahead.”* (Administrative Person A, interview transcript 2-9)

Thus, as the system went live, project managers were resisting its use and continuing to use existing systems, researchers were generally reporting their time faithfully to projects and other activities, and Center management reconciled the activities of the Center with the budgets of the projects and other general costs. Thus, with the example of the separate spreadsheets, we found loose coupling between the performative allocation of budgets in any given time period with the ostensive budget, or the budget within the system (P-O).

In the months after go-live, the overall Center budgets and associated administration changed little from the time of go-live. However, at the level of researchers and local
research management, groups began to see that billing too much of their time to the G&A overhead account. One researcher summarized this rationale:

Well, if you’re going to charge to overhead tasks, it looks like you spent a lot of time on something and didn’t get much done. Don’t charge to overhead because it makes us look bad. It’s better off to have the people look like they cost less and that they’re inefficient than it is to have the people cost more but when they are working a task, they’re efficient. (Researcher D, interview transcript 3-2)

This pressure to show less overhead-related time stemmed from management as well as the level of the researchers. High level research managers helped justify this activity:

You ask employees to charge all their time to a project and they push back saying, well the time we spent at a branch meeting, we can’t charge that to a particular project. I say, spread it across ... may not directly be in support of a project, but indirectly they support, they make you a more knowledgeable person about the things that are happening at the center. So ... some benefits to a project. (Research Manager B, interview transcript 2-19-04)

Therefore, although the load balancing remained, to an extent at the center management level, it also took place at the level of researcher, who were now encouraged to bill their G&A time directly to projects. From this we see another form of loose coupling – that of a researcher’s performative activity with his or her own performative activity (P-P). In this sense, actual performative activity of the research tasks is translated (often not precisely or accurately) to the actual performative activity of tracking time in the system. The performative, material, and ostensive aspects of practice are all aligned as the researcher reports time, however, the data the researcher uses to represent the researcher’s time is not directly representative of that actual time, in many cases.

With the transition of NASA’s focus more to space missions (T4), many Aeronautics programs were cut and those project managers were transitioned to space programs, when
possible. Also, researchers were expected to advocate for their work and get space programs to buy into the applicability of their capabilities. As one researcher reflected:

_There was a big emphasis because we had this imbalance of work and people of actually, at least here at Glenn, doing a lot of proposals to actually go and propose to bring new work into the center._ (Researcher F, interview transcript 2-15-08)

However, this proposing was not as effective as it could have been at Glenn for two reasons: the first was due to the politics of large government organizations, and the second was due to the cost of doing business with Glenn. A research manager indicated that many of the performing organizations were “shooting blind” in 2005 and 2006. Research management was pushing “propose, propose,” and oftentimes these organizations did not even get responses for their proposals because they were not sure what the programs were looking for, what criteria they used, the leaders were not politically connected with the programs, and the bidding for funding was highly competitive (Research Manager E, field notes 3-25-08).

The other reason for missing new projects was because of the bloated overhead accounts. As more individuals were not funded by projects, they became employed by G&A. Then the cost of G&A was spread like a tax on funded projects, increasing the rate associated with funding a working researcher. The cost of using Glenn researchers became prohibitive as these taxes increased:

_Our center managed to get around that and take a lot of the control of the money from the project office. By decree, they will do things like with the rates for example. The rates continuously will go up... For the whole life of full cost, I can’t tell you how many times either myself or my project managers will take a beating from our customers for raising the rates. I’ve got an example myself. I went down to Johnson with my project manager on the Shuttle Program to do what they were calling a zero-base review of all the return-to-flight work that the agency was doing. That shuttle was trying to build their budget. I checked with our RAMO office on the rates. They_
told me the rates were stable and they were not going to change. So we went down, presented a budget to their program... I kid you not, this was like a Thursday. The next week on a Monday, I got an e-mail saying the rates went up. (Project Manager G, interview transcript 2-4-08)

While they were looking for new funding, researchers who did have funding tended to report as much of their time to projects they were on, if possible.

Generally people are told to charge their time to either the project they just finished or the one that’s coming up because they want to keep their overhead rates down. Supervisors who never had anything to do with the test – don’t even know what the test is about – are even charging their time to the projects, too and so you end up with [a skewed] number of what it really costs to run a facility or to do a test. (Research Manager D, transcript 2-17-04).

Since research is unpredictable, throughout the interviews it was evident that load balancing was a continuing concern for project managers.

“We could balance resources, we could phase work in and phase work out... Sometimes projects would run into a technical development problem and require more resources. We could slow another project down to take some of its resources and rebalance our portfolio from a financial performance capability. We owned control of multiple projects... You’re robbing Peter to pay Paul... in the end the projects use the resources that were necessary to deliver the project. They won’t use the resources you predicted them to. Some will be higher. Some will be lower.” (Project Manager E, interview transcript 2-11-08)

While interviewees indicated that in the past, this ability to balance resources rested on the shoulders of strong-willed center managers who would “insulate” or “protect” the researchers from the pressures outside of the center (Researcher H, interview transcript 4-7-08). In the current governance structure, we saw some such authority evident in the project management role:

“For that one year things worked really well and some money that we had told them we might need for rate increase and those kinds of things, at the end of the year, we didn’t need. It was about three hundred thousand. So we gave them two hundred. All the new audiovisual equipment that’s in the auditorium, sixty thousand of that was
On the research side, there is now limited leeway:

“Maybe a project would have some leeway. The numbers they give me, that’s what I fit to. If for some reason I can’t, then I get an opportunity to say, “Hey, I need more money. Here’s why I need more money.” Then the center as a whole will look within the center’s institutional budget and see if they can move money from my discretionary fund, because they always maintain some discretion to cover emergency bills. Other than that, I get handed a budget, I get handed a set of numbers based upon specific areas that we’ve identified. That’s the numbers I march to. When they give me money, I buy those licenses, I buy that hardware. There is no leeway. I have to ask for very specific stuff and specific numbers.” (Research Manager B, interview transcript 2-6-08)

Of course, one way that a form of load balancing within research organizations can take place is on the micro-level of researcher hourly time tracking.

Researchers are expected to bill all of their time to projects. While a number of veteran research managers can attribute their time to a “technological excellence” account that was created specifically to retain particularly valuable knowledge resources, everyone else must bill to funded projects, which it appears that they do. It seems that, although researchers are still involved in advocating their work, the pressure has been relieved a little during Griffin’s tenure. An interesting point, however, is that researchers tend to divvy their time proportionally to budgets based on how much time they are allowed to bill to each budget. So even if a researcher spends all of his time on a single project over the course of a given month, if he is able to bill to three projects proportionally he does so.

You have several projects that you work on and you’re allowed to charge so much time. The challenge is to try to make sure you get enough time to get a forty-hour week. Then you divide it in proportion to what you’re allowed. Actually very few people really put the number of hours on there that they really worked on a project.
They get so much and they just distribute it, because it’s way too hard to keep track. ... People don’t count how many hours they work on each thing and then charge that way, because it would never come out to be forty hours and it would be too complicated. (Researcher C, transcript 2-4-08)

There are situations where researchers and other personnel may accidentally bill to the wrong account, or they may have some time where they are unfunded – so they bill one of the wealthier WBS numbers – often jumping across a number of such numbers, what one informant described as “surfing.” Sometimes innocently and sometimes illegitimately, many individuals in performing organizations are actively looking for projects to continually bill their time. Thus all project managers we interviewed, just as Project Manager G above, reported spending a great deal of time retrospectively monitoring and following-up on people who report time to their billing numbers.

Figure 13. Shift of Funds Allocation Control to Project Management Organizations

Figure 13 captures our qualitative impressions of the relative magnitude of control of three groups over the course of the study. In T1, the managers in the centers who oversee performing organizations and institutional resources have discretion over their budgets,
and, in turn, the budgets are at the discretion of center top management. Researchers were insulated by budgeting and have no real control over the allocation of funding. In T2 and T4, researchers become active in the allocation of funding, because the way they record their time has a direct impact on overhead and project accounts, and they have some leeway relating to this timekeeping. Center managers lose much of their control over this funding in this time, but project managers do not seem to gain any. T2 and T4 represent a transitional time where the net control over budgetary allocation is, at least partially, out of control. With the elimination of Full Cost and the rise of Programmatic Budgeting, project managers emerge with a large portion of the control and discretion over budget allocation, although the activity has enabled researchers some discretion within the bounds of approved budgets.

From this brief presentation we see loose coupling across two different levels of analysis – the task level where there is an emphasis on integration of researcher purchasing activity, and the project level where the focus is on control relating to project tracking. We found a good deal of loose coupling, across both integration and control, that was maintained over time. With all of this loose coupling, does that mean the enterprise system was a failure? We argue that it was successful. Next we will address this overall success of the project.
Overall Enterprise System Success

In determining whether the overall implementation of the enterprise system can be deemed successful, we will compare a number of broad outcomes evident in the data with the list of original objectives that were mentioned in the section on NASA’s structure. Following is a list of various successes that were evident in our research. This list is not exhaustive, but represents some highlights of the system implementation that support our appraisal of system success.

1. **Accountability and Legitimacy** – As a part of the U.S. Government, NASA is beholden to other branches of government and must establish itself as a responsible, reliable agency (or at least the convincing appearance of such). This has been a problem throughout the history of NASA, as many activities are so unpredictable and budgets are politically motivated that little can be predicted (Center Manager B; Researcher G). In the example of the International Space Station, audits from the GAO (2002-2005) repeatedly indicated that NASA simply cannot report how much money the Agency spent on the project. The GAO then offered five prescriptions for NASA to improve accountability through Integrated Financial Management. In the only audit report since 2005, the GAO (2007) reported that NASA had, in fact, addressed the GAO concerns with Integrated Financial Management; and an audit of the International Space Station (GAO 2008) used budgetary numbers from NASA, with apparent faith in these numbers. We could find no evidence that NASA continues to have problems reporting the costs associated with the Space Station effort.

2. **Financial Integration between Centers** – Before the enterprise system, each Center had its own system and project managers avoided moving funds between centers because it took weeks and would sometimes get lost (based on data from Project Manager G, among others). Now project teams can transfer funds without losing them in a few intermediated clicks (Project Manager C). Without this financial integration, the collaboration required to realize One NASA and Ten Healthy Centers would not have been possible.

3. **Control Transition** – A key goal of both the former Full Cost, and the current Programmatic Budgeting, was to put the control of funding, and thus the activity of the Agency, in the hands of the Strategic Enterprises. Although this control is imperfect (evidenced by surfing WBS numbers, load balancing, and creative time charging), the organization has made a number of tough decisions to drop certain capabilities and transition personnel to the work funded by projects and programs. Funding decisions are now in the hands of
the programs and projects (Project Managers E&G), and center management has lost much of the discretion they once had (Research Managers D&B; Center Manager A; Researcher H). Without the enterprise system this simply would not have been possible.

4. **Time Tracking** - The time and attendance portion of the enterprise system (WEBTADS) is used Agency-wide, and has been hailed as the best such implementation of a time and reporting system in the U.S. Government.\(^{22}\)

5. **Purchase Requisitioning** – Although doubly mediated, if all goes well, new purchase requisitions make it to the appropriate procurement staff or buyers within a day. In the past this took more than a week (Service Checker B).

6. **Project Reporting** – Project Managers and related staff indicated that their intermediated use of Business Warehouse, reporting from the system is now adequate for their needs (Project Managers C, F, G, D, E and Administrative Project Support C).

7. **Technical Success** – The system is implemented and stable, performs adequately, received a presidential “green light” assessment, and is supported by a dedicated competency center (Implementation Manager B&C). Further, upgrade goals have been met on time, and the Agency is making progress on governance processes and compliance with oversight recommendations (GAO 2007).

To assess these positive findings in relation to system success, we compare them to the two goals we presented relating to the initial implementation (See NASA Press Release 9-22-00):

- **It will provide timely, consistent, and reliable information for management decisions.**
  - Mixed Support: This goal involved single point of data entry, consistent data, and comprehensive reporting tools. Single point of data entry is simply not the case, there does in fact appear to be data consistency (consistent, but in the case of some of the time reporting, for example, not entirely accurate), and mediated reports provide data needed for retrospective project management (see: Project Reporting above; also see Financial Integration)

- **It will improve NASA’s accountability and enable full cost management.**
  - Strongly Supported: NASA needed to understand how much was being spent on projects, control resources, and provide consistent visibility to management

and oversight organizations in the government. Although mediated by some load balancing on center, project, and individual levels, the projects now have control of the Agency funds, although largely reactive control, and the Agency has thus increased accountability (see: Accountability & Legitimacy and Control Transition above).

Through this brief analysis we conclude that the enterprise system implementation can be deemed successful. A potential objection to this perspective may be that this success is incomplete, as not every objective was fully, unequivocally met. In response to this potential objection, however, we argue that the first three are the key goals of the enterprise system – establish legitimacy with oversight groups outside of NASA (Congress, OMB, GAO), unify the financial systems across the Agency, and transfer control of these funds to the Strategic Enterprises. Each of these broad goals has been met.

In our analysis of situations that involve the loose coupling of organizational practice to the enterprise system, we identified two broad processes where we found evidence of some form of loose coupling: the researcher purchasing & project tracking processes. Although looser coupling was evident in our data than these two processes, we chose these processes because they represented the two general forms of loose coupling that we identified in the organizational literature (Table 1): the project tracking process involves an attempt to control, whereas the researcher purchasing process involves integration between functional units based on a streamlined process. Next we will present our research into the way the relationship between the goals and expectations of the implementation (ostensive aspect); situated practices (performative aspect); and system functionality (material aspect) played out over time in these two processes.
Discussion

Orton & Weick (1990) refer to their treatment of loose coupling in organizations as “the theory of loose coupling” (see figure 1). Yet the theory they propose is more of a structure for theorizing, as the causes, effects, and interactions they discuss are generic and adaptable to a variety of environments. What do the terms “fragmentation” and “buffering” between subsystems mean in all organizational contexts? No, the theorizing that that Orton & Weick put forth is not a theory in the traditional measure, predict, and explain sense of the term. Nor is it a grand theory that attempts to encompass universal philosophical or social truths. Rather, loose coupling has been described as a metaphorical lens (Morgan 1980) through which we can view organizational phenomena. The metaphor of a loosely coupled system was created specifically “to counter the assumptions implicit in mechanical and organismic metaphors that organizations are tidy, efficient, and well-coordinated systems” (Morgan 1980). While such metaphors do not represent theories, in their traditional sense, they can be used to generate such theory. One can legitimately argue, certainly based on the assumptions we identify in Table 3, that enterprise systems are generally characterized in terms of mechanistic metaphors that involve concepts such as control, integration, and the elimination of misalignments. Therefore, this body of work is ripe for new theory that postulates an alternative, or perhaps complementary set of assumptions. The lens of loose coupling affords precisely this set of assumptions. Table 3 addresses each of our research questions based on the data presentation, and these findings are discussed in the next section.
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<thead>
<tr>
<th>Table 3. Questioning Assumptions about Enterprise Systems with Loose coupling</th>
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<tr>
<td><strong>Assumptions</strong></td>
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<tr>
<td>1a</td>
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<td>The goals of enterprise system implementations involve integration and control.</td>
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<td>1b</td>
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<tr>
<td>The relationship between integration and control is mutually reinforcing</td>
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<td>2a</td>
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<tr>
<td>Misalignments adversely affect the goals of the enterprise system (i.e., integration &amp; control).</td>
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<td>2b</td>
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<td>Misalignment should be resolved through mutual adaptation of the system and relevant practices.</td>
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<tr>
<td>2c</td>
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<tr>
<td>Many or deep misalignments will hamper successful enterprise system implementation.</td>
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Integration and Control over Time

To make sense of the way that loose coupling plays out over time, we adopted the image of “mutual adaptation” (Leonard-Barton 1988) for the illustrations we used to depict our analysis (Figures 6-13). This image implies a dialectic relationship between changing ostensive, material, and performative aspects of business processes, which are expected to converge over time if the system will be successful. Taken a step further, a lens of mutual adaptation promises eventual integration, if only the system and practice would be properly changed together.

What is immediately apparent in the data is that none of the incidents of loose coupling (or decoupling in the case of project management reports) were resolved to eventual integration consistent with the initial ostensive aspects of the processes. In every case, NASA settled for less than perfect integration along some dimension or another. For example, in the case of the header information, data integration was imperfect; in the case of mediated system usage, process integration was imperfect; and in the case of researcher project tracking, structural integration was imperfect. In the strict sense of full integration that was originally planned – the promise of “a single point of data entry which will eliminate reconciliation” (see NASA goals p.30) simply did not result. Although we did not find the result of alignment in the form of perfect integration, we did see the process of mutual adaptation, but what we found was that when loose coupling was evident upon implementation, after periods that can be characterized as mutual adaptation, the relevant business process appears to settle into what we describe as a “semi-stable state of loosely coupled equilibrium.”
This loosely coupled equilibrium, although perhaps consistent with the de facto reports of some research projects (i.e., Wagner & Newell 2006; Boudreau & Robey 2005), has not been explicitly articulated as an end to the process of mutual adaptation. Researchers tend to associate cases where alignment does not occur as problems with the implementation (Wei et al 2005) or cause for failure (Sia & Soh 2007), not as a source of stability. There is a body of research based on Ciborra’s (2000) notion of “drift” that does indicate that enterprise systems as mechanisms of management control continually drive cycles of unintended consequences, which, in turn, require more efforts at control, and more unintended drift. Although this perspective has been supported by a body of research (Chae & Lanzara 2006; Nielsen & Aarestadt 2006; Elbanna 2006; van Fenema & van Baalen 2005), our analysis of loose coupling in NASA’s implementation seems to contradict this notion of drift. Instead, we find that when some state of loosely coupled stability is maintained, that loose coupling became institutionalized across the Agency, and in every case was reported to be fairly stable for at least a year before our second round of interviews.

This observation is particularly important in addressing the control associated with enterprise systems. Contrary to the theory of drift, in our data we found that attempts to control activity did, in fact, improve control to an extent, albeit never exhibiting perfect control. For example in the P-card purchasing situation, there were concerted efforts to limit P-card purchases in response to certain activities that circumvented control, such as the splitting up of purchases in increments and the purchase of sensitive product such as personal computers. Further, researchers also avoided imperatives of the system such as the rationalized selection of vendors or the limitation of certain “sensitive” products such
as personal computers. As control is tightened over these activities, researchers are still finding ways to get what they want, and not subjecting themselves to the complete control of the imperatives of the system, yet the full scope of their activity is limited.

In the time reporting example, what appeared a wildly ad-hoc and unstandardized activity in 2004 evolved into what appears to be practices that are significantly more disciplined, but still not tightly coupled. The replacement of the G&A “catch-all” account with a specific CM&O program was an attempt to increase control on time reporting. This resulted in the proportional allocation of time, and the increasing phenomenon of “surfing” across funding codes. Such activity requires project managers to spend more time monitoring and investigating situations where people bill to their accounts. As time continues to go inconsistently reported, and researchers continue to circumvent the imperatives of the system, effort is made to control this activity, which results in newer, unforeseen adaptations. However, there is a sense that the domain of these adaptations become less and less extreme, suggesting a ratcheting down of control, with the realization that perfect control is unattainable – but a semi-stable state of loosely coupled equilibrium likely is attainable. *Thus in situations of loose coupling where we see a dialectic interplay of increased control and responses to the control, stability and the absence of full control (rather than drift) appears to be the result.*

Thus the evidence of loose coupling tends to be resolved not through the tight coupling that was initially envisaged, but rather through some adjustment process to eventually a stable state of loose coupling at the local level. This loosely coupled stability appears to run counter to the goals and assumptions of the enterprise system in the first place. However, many of the overall goals for the implementation are being met unequivocally.
For example, the purchasing turnaround time has been reduced from a week to a day (Service Checker B); the funds transfer between Centers in a project context is now immediate, where it previously took weeks (Project Manager C); and the locus of control for the allocation of project funds has moved dramatically over the years from the Centers to the program and project groups. With this insight, we develop the central thesis for this research: through loose coupling between ostensive, material, and performative aspects of business processes at the level of specific activities, an enterprise system can attain a stable position in the organization. This stability, in turn, allows for increased integration and control at a level of the overall organization.

Thus the stability of the system, it can be argued, is vital to the success of the enterprise system, and while stability often requires that an organization compromise some integration and control at an activity level, it is precisely this stability that enables outcomes related to increased integration and control at an organizational level. Next we will develop a model for a relationship between overall stability, integration, and control with the common success factors approach to enterprise system implementation, then conclude with a provocation whereby the enterprise system itself can be interpreted as a mechanism for loose coupling itself.

**Loose Coupling and System Stability**

Large, standardized IT infrastructures inevitably fit better in certain locations of an organization than with others, but there is often no choice but to use an enterprise system, even if it is inconsistent with local practices. Thus, practices that loosely couple ongoing activity with the imperatives of the system simultaneously enable the use of the system
and the locally situated activity. Over time, the semi-stable state of loosely coupled equilibrium that we found in evidence in the data appears to directly enable the continued system use overall.

This observation stands in direct opposition to the prevailing assumptions in enterprise system research. Much of the existing research indicates that when misalignments between the system and its use are not eventually aligned, this challenges the overall implementation, and eventually may lead to failure (Wei et al 2005; Light & Wagner 2006; Volkoff et al 2005; Sia & Soh 2007). Our research instead takes the perspective that this alignment can never be expected across the diverse, pluralistic practices throughout a large organization. Therefore, some loose coupling will inevitably be evident in places throughout the organization, and this loose coupling actually enhances the possibility of an enterprise system’s success (rather than undermining that success). Thus, as loose coupling involves less integration and less control, and system success results in more integration and more control, we are essentially making the argument that less integration and control results in more integration and control. To resolve this apparent dilemma, we propose a multi-level model (Burton-Jones & Gallivan 2007) for system success that highlights the role of loose coupling and stability (see Figure 14).

In the “critical success factors” literature for ERP implementation (Holland & Light 1999; Hong & Kim 2002; Al-Mashari et al 2003; Akkermans & van Helden 2002), a variety of common factors have been identified that increase the likelihood of a successful enterprise system implementation. Only through a successful implementation can ERP-related outcomes be realized. Of course, in an enterprise context there is no definitive “success” moment (Markus et al 2000) and successful outcomes must
continually be reestablished. Thus, we argue that the stability of the system over time mediates the relationship between implementation-oriented success factors and the implementation success and resulting outcomes.

Since enterprise systems are implemented across diverse, pluralistic activities and individuals, the only way this stability can realistically be realized is by finding some accommodation at a local level. In the case of NASA, perhaps the direct system use of researchers is not entirely necessary. Also, since NASA is a government organization, perhaps all relevant data does not need to be captured in an integrated fashion, but can be stored in a header. These situations do not undermine the overall role of the enterprise system as a central repository and coordination technology, though they do require the organization to reduce expectations for the system a bit.
Therefore, loose coupling at the level of specific activities enables simultaneous fulfillment of contradictory or orthogonal goals with responsiveness to the system. In the case of NASA, the mediated usage allowed valuable knowledge workers – researchers and project managers – to avoid learning a system that was generally described as not user friendly; to avoid keeping track of all of the intricacies of a government procurement process; essentially, to avoid becoming the “hybrid-accountants” that Caglio (2003) suggests ERP users must become.

Through loose coupling at the level of activity, local goals that incompatible with the imperatives of the system can also be realized. For example, the goal of a single data repository covering all needs of diverse business processes is naïve at best (Dechow & Mouritsen 2005), but the repository can be appropriated in unique ways, becoming loosely coupled with itself as with the procurement header, or it can be periodically reconciled with the shadow systems that enable individuals to do their work – as with the case of the project management reports. These examples do not represent grave misappropriations of the system, but they do highlight the necessity of some loose coupling at an activity level to allow for integration at the overall process level.

Finally, as Burton-Jones and Gallivan (2007) indicate, the outcomes at the overall process level – such as the rapid purchasing activity or the quick funds transfer capabilities – potentially enhance the local outcomes – such as the efficiency and knowledge work of researchers and project managers. Similarly the outcomes on the individual activity level – such as satisfaction of researchers and project managers with the system – enable the recursive management and accountability of these knowledge workers.
As our evidence indicates no necessary relationship between integration and control. In the data we found instances where integration and control seemed to correlate (procurement functionality), where they were inversely related (purchasing approval), and where they were orthogonal (P-Card process). Further, data integration did not necessarily require process integration (as in mediated usage) nor did process integration require complete data integration (the researcher purchasing process). As our overall study shows, certainly a high level of structural integration does not require complete data and process integration. Instead, we hold that loosely coupled local activities are necessary for system stability, and that this stability is necessary for the overall structural integration (Barki & Pinnsonneault 2005) as well as the control enabled by both some procedural constraints (Kallinikos 2004) as well as the surveillance associated with more disciplinary forms of control (Elmes et al 2005).

Thus we may arguably conclude with this multi-level theory of the relationship between loose coupling on a local level enabling tighter coupling on an overall process level. However, one might also legitimately question whether that tight coupling on the level of overall business processes similarly contributes to loose coupling on an organizational level of analysis. We conclude by addressing this possibility.
The Enterprise System as Loose Coupling

Complex organizations are often conceived as “loosely coupled” systems, where many processes and groups are necessarily insulated from each other in order to allow different specialties to attend to different, often incongruent pressures, and thus adapt and persist over time (Orton & Weick 1990; Perrow 1984; Scott 1987; Weick 1979). In particular, loose coupling within organizations is deemed critical to issues relating to innovation and knowledge creation (Brusoni & Prencipe 2001). NASA is certainly an organization heavily concerned with both innovation and knowledge creation, and given all of the pressures on the organization, one would argue that it can only persist through loosely coupling some inconsistent organizational structures from each other.

However, enterprise systems are all about tight coupling. Single point of data capture, process integration, control, accountability, standardization – these are all terms commonly associated with enterprise systems. Funding sources in both the Executive and Legislative branches of the U.S. Government – through OMB and GAO audits – put a great deal of pressure on NASA to show integration, control, accountability, and standardization through an integrated financial management system. As this system is up and running, stable, and balances its overall budgets on a high level, the fact that there is non-integration, some lack of control, etc. in the ranks and at the fringes of the system is really not material to these organizations, as long as it all balances out in the end. These other branches of the U.S. Government cannot control NASA’s activity at any deep level of granularity, nor can they control outcomes to any great extent, due to the nonlinear, unpredictable, radically innovative nature of the work. Thus maintenance of legitimacy is a key concern for NASA, and a primary reason for implementing the enterprise system.
Through loose coupling in key areas – such as the reporting and tracking of researcher activity, load balancing of budgets at either the center or project levels, and to a lesser extent, through mediating the system use valuable knowledge workers – a good deal of Although these notions of organizational legitimacy are well-established in institutional and organizational theory (e.g., Meyer & Rowan 1977; Brunsson 1989), they are rarely addressed in the context of enterprise system implementation. In the instances where “institutional pressures” are brought to bear in conjunction with enterprise system efforts (Gosain 2004; Liang et al 2007), the apparent results involve tight coupling and mechanistic imperatives consistent with tight coupling across the organization.

An interesting point is that, while the enterprise system was, to a large extent, implemented for purposes that involved legitimacy, and even in the context of a good deal of loose coupling, key inter-Agency financial integration did occur, and the control over budgets did transfer largely form the Center managers to the project managers. On a large scale, the objectives associated with integration and control did occur, even if they occurred imperfectly on a local level. Thus the outcomes of then enterprise system are threefold: (1) the enterprise system enables a façade of neat, orderly fixed budgets and linear progress; (2) the enterprise system allows for integration and control at a high level; and (3) the integration and control associated with the system is imperfect and not all-encompassing, providing a (necessary) space for local indeterminacy, nonlinearity, and surprise. As Figure 15 indicates, the locus of loose coupling may have moved – whereas in the past the center managers were key insulators of research activity, much the way the “technical core” is insulated by management from environmental turbulence in classic management literature (Thompson 1967). As the notion of loose coupling
indicates the presence of both tight coupling and partial or non-coupling, this analysis of NASA’s enterprise system implementation finds that the enterprise system itself, complete with all of the trappings of a tightly coupled, mechanistic organization, may actually be a mechanism for loose coupling at an organizational level. Through the legitimizing role of the notions of “integration” and “control” (Dechow & Mouritsen 2005), the enterprise system may enable maintenance of loosely coupled structures.

Limitations

This research represents an effort to generate grounded theory about loose coupling from the case of NASA’s ERP implementation, and due to the unique context of NASA, as well as some of the choices in emphasis that we made, there are certain limitations and biases in our research. First, although our goal involves theoretical inference (i.e., analytic generalizability, Yin 2003) rather than statistical generalizability, we leverage a fairly extreme case. NASA is a government Agency on the one hand, and a radically innovative organization on the other. Very few organizations are likely subject to the indeterminacy and turbulence on the scale of NASA. Certainly for-profit corporations do not have the luxury of decades of development before delivering a product. However, the domains that we addressed arguably evidenced many commonplace features and we could see similar dynamics playing out in other organizations that have knowledge workers – certainly heavily institutionalized organizations such as other government agencies, hospitals, and universities (which are all increasingly engaging in enterprise system implementations) – but also the many corporations with engineers, scientists, salespeople, and other such organizational members that might benefit from loose
coupling. An effort to test the propositions generated here would help understand the
generalizability of our findings.

Also, Barley (1986) warns that longitudinal research that is based on individual
recollections is suspect, and in the case of this research, constructions of the incidents in
T3 and T4 are largely retrospective constructions. While this is certainly a limitation, we
feel that in interviewing thirty of the same informants twice, out of a total sample of 110
interviews, we were able to triangulate a bit on some of the incidents and thus overcome
some of the limitations associated with recollection. Further, our unit of analysis was not
the micro-activities where ethnographically-oriented interpretive research generally
focuses. Rather, ours focused on broader organizational processes using a hermeneutic
form of inquiry (Boland 1985), with the interview transcriptions and NASA documents
as the text. Therefore our propositions depended vitally on the way individuals made
meaning. So our research is subject to the validity issues relating to the double
hermeneutic (Giddens 1984) associated with such research - informants making meaning
of their experience-as-text, then our analysis of their sensemaking.

Another limitation of the research is that in the presentation we focus only on incidents of
loose coupling, and these incidents of loose coupling involve “peripheral” process
participants, in that scientists and project managers are not primary users of the system,
but knowledge workers who would only use the system part-time at best. While there
was a great deal of tight coupling evident in the data, this was not the focus of our
research, and would not help us address our research questions, so the many lessons we
may have learned from focusing on them (perhaps from a counter-factual perspective)
must wait for a future research opportunity. Also, by focusing only on these peripheral
participants, we did not gain insight into loosely coupled activities of key, full-time users of the system (such as accounts payable clerks or financial analysts). While we interviewed a number of such people, and their data informs our research from a contextual standpoint, it was not addressed in the analysis presented here. The outcome of this trade-off is that our analysis primarily applies to the part-time, peripheral, or knowledge worker form of enterprise system user. For our overall argument, however, this is precisely the population of interest in determining the impacts of loose coupling on overall system success, as these users tend to be key originators and consumers of enterprise system data. Further, if one is to understand the impacts of an enterprise system on issues such as innovation, these are precisely the type of users that would apply.

**Conclusion**

Through our research into the NASA case, we find a great deal of non-integration and limited control to be in evidence. Using the lens of loose coupling in the context of business processes, we presented situations of loose coupling and paid particular attention to the impact of the loose coupling we identified on key organizational outcomes of integration and control. Based on our analysis of the findings we developed a multi-level model of how loose coupling maintained over time, while ostensibly undermining the integration and control implied by the system, can indirectly enable this integration and control at a higher level. Further, we conclude with the counter-intuitive argument that a tightly coupled enterprise system can, in practice be a mechanism for loose coupling, enabling legitimatization and tight integration on an organizational level, while allowing for local situated actions subject to less-than-complete levels of integration and control.
The relevance of these findings to both research and practice can be addressed using the widespread assumptions we identified, which we will now briefly address (Table 3). First, the imperatives of integration and control are generally thought to be the primary goals associated with enterprise systems, and these two goals are entirely consistent with each other. Using a lens of loose coupling, we found that another key goal – certainly in the case of NASA – was legitimacy and the appearance of a neatly-ordered organization. Based on this goal of appearance, stability was, in practice, of higher value than either integration or control in certain instances. We found that in certain instances of loose coupling, integration and control were actually inversely related, and in other situations they appeared orthogonal. While the prevailing literature tends to characterize the two concepts as mutually-reinforcing, our analysis points toward the need for more detailed, specific operationalization of these concepts.

Further, the received wisdom indicates that misalignments are not desirable and should be resolved through a process of mutual adaptation to result in eventual integration. Too many misalignments or very deep misalignments are generally thought to result in system failure. Our analysis contradicts many of these characterizations. First, with the focus on stability as a key goal of the system, loosely coupled misalignments actually stabilize the system implementation without the complete alignment that is generally deemed necessary. Instead of complete alignment, a stable state of “loosely coupled equilibrium” results from a mutual adaptation process. Thus, the many or deep unresolved misalignments themselves need not result in system failure, as long as some less integrated, and/or not tightly controlled alternative can be reached. Misalignments on a local level can still enable integration and control on a higher level of organizing.
As organizations spend hundreds of billions of dollars on enterprise systems, it is imperative that they understand the notion of loose coupling and its applications in this domain. Loose coupling can foster innovation, can render ERP data meaningless, can provide a space for individual flexibility, and can undermine accountability. This research is step toward understanding the value as well as the challenges of loose coupling in enterprise system implementations.
References


Foucault, Michel, (1972) *The Archaeology of Knowledge*, translated by Sheridan Smith, Pantheon Books, 1072


Polanyi, Michael, (1966) *The Tacit Dimension*.


