THE RECURSIVE DUALISM OF TECHNOLOGY: RECONSTRUCTING THE PROCESS OF TECHNOLOGY ADAPTATION IN ORGANIZATIONS

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The notion of technology is often consumed with its purely practical, equipmental interpretation in everyday life which assumes the neutrality of technical things, fully justifying the equivocation of the technical with the technological. However, technology, as a major constituent of contemporary society, is intimately connected with politics, economics, culture, and all forms of social and personal life. Previous research followed a variety of approaches and analyzed the technology phenomena in organizations from structural or agency-based perspectives. The structuration theory, attempting to resolve the deep-seated ontological division in social sciences, has offered a way out from the impasse between structure and agency based perspectives, but a number of criticisms have been posed against it in the literature (Clegg 1989; Archer 1982, 1989, 1995; Layder 1987; Callinicos 1985; Mouzelis 1995). Following the structuration theory, Orlikowski (1992) suggested the structurational model of technology and offered the duality of technology model.

In this study, the recursive dualism of technology (RDT) model is developed as a new theoretical model to provide an understanding as to how technology is experienced and the way technology adaptation unfolds in organizations. The model explains how technology shapes and also is shaped by organizational affairs at macro, meso, and micro levels in organizations. The RDT model combines structuration and institutionalization perspectives, reconsidering criticisms against the structuration theory. A set of theoretical propositions has been developed also drawing from the power literature to describe the interplay of actors and structures using "power-based institutionalization mechanisms" (Lawrence, Winn and Jennings, 2001) during technology adaptation in organizations.

Research propositions have been empirically studied in five cases of Enterprise Resource Planning (ERP) software adaptation in four different organizations. ERP is a software technology frequently associated with organizational change and transformation in relation to its adaptation in organizations. Case studies are compared and contrasted to empirically evaluate the RDT model and discuss the process of technology adaptation in organizations in relation to structuration and institutionalization processes. The theoretical and practical implications of the study and potential further studies are also addressed.

TEKNOLOJİNİN ÖZYİNELİ İKİSELLİĞİ: ÖRGÜTLERDE TEKNOLOJİ ADAPTASYONUNUN YENİDEN YAPILANDIRILMASI

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Anahtar Kelimeler: teknoloji adaptasyonu, kurumsallaşma, yapılandırma, kurumsal kaynak planlaması, sosyal yapı ve aktör

Teknoloji kavramı günlük hayatta genellikle tamamen alet ve ekipman gibi algılanarak kullanım pratiği içinde anlamlandırılır. Bu yaklaşım teknik olan şeylerin tarafsız olduğu kabulüne dayandığı için teknik olanla teknolojik olanı birbirine eşitlemektedir. Ancak, günümüz toplumunun önemli bir bileşeni olarak teknoloji, sosyal ve kişisel hayatın politik, ekonomik ve kültürel olan her şekliyle yakından ilişkilidir. Önceki araştırmalar, bir çok yaklaşım kullanarak, örgütlerde teknoloji fenomenini yapı veya eylem perspektiflerinden analiz etmişlerdir. Yapılandırma teorisi, temeli derinlere dayanan sosyal bilimlerdeki bu ontolojik bölünmeyi çözmeyi deneyerek bu ayırımdan bir çıkış yolu önermişse de bir çok eleştiri almıştır (Clegg 1989; Archer 1982, 1989, 1995; Layder 1987; Callinicos 1985; Mouzelis 1995). Buna karşın, Orlikowski (1992) yapılandırma teorisine dayanarak teknolojinin ikiciliği modelini ortaya atmıştır.

Bu çalışmada, teknolojinin özyineli ikiselliği modeli, teknolojinin örgütsel ortamlarda nasıl deneyimlendiği ve teknoloji adaptasyonun nasıl gerçekleştiğine yönelik bir anlayış sağlamak üzere yeni bir teorik model olarak geliştirilmiştir. Model teknolojinin bir örgüt içerisinde makro, mezo ve mikro seviyelerde örgütsel ilişkilerle nasıl şekillendiği ve bu ilişkileri nasıl şekillendirdiğini açıklamaktadır. Model, yapılandırma teorisi ile kurumsalcı yaklaşımları bir araya getirirken, yapılandırma teorisine yönelik

eleştirileri de yeniden değerlendirmektedir. Bunun yanı sıra, örgütsel yazındaki güç temelli yaklaşımlardan yola çıkıp "güç-temelli" kurumsallaşma mekanizmalarını (Lawrence, Winn and Jennings, 2001) kullanarak örgütlerde teknoloji adaptasyonu sırasında aktör ve yapıların ilişkilerini teorik önermeler biçiminde tarif etmektedir. Geliştirilen önermeler, dört farklı örgütte geçen beş Kurumsal Kaynak Planlama (KKP) vakasında ampirik olarak incelenmiştir. KKP, örgütlerdeki adaptasyonu ile genellikle örgütsel değişim ve transformasyonla ilişkilendirilen bir yazılım teknolojisidir. Vaka çalışmaları karşılaştırılarak, model ampirik olarak değerlendirilmekte ve örgütlerdeki teknoloji adaptasyonu süreci, yapılandırma ve kurumsallaşma süreçleri ile ilişkili olarak tartışılmaktadır. Bunun yanı sıra, çalışmanın teorik ve pratik sonuçları tartışılmakta ve takiben yapılabilecek potansiyel çalışmalar önerilmektedir.

1

INTRODUCTION

Technology, as a major constituent of contemporary society, is intimately connected to all forms of human affairs and is considered as an important topic in organization studies, social theory, and philosophy. The increasing involvement of new technologies in organizations has revitalized debates on the relationship between technology and organizations. To develop a comprehensive understanding of the interactions between technology and organizations, the adaptation processes through which technology structures organizational action as well as agency enacts technology needs to be thoroughly explored.

The origin of the word "technology" can be traced back to Greek word *technologia,* which was a combination of *techne,* which means "craft" and *logia*, which means "saying". The meaning of the term encompasses the knowledge of humanity's tools and crafts and can be defined as "the practical application of knowledge" (Merriam-Webster, 2006). If all technology can be considered in terms of applied knowledge, this would imply that there is no inherent difference between the various types of technology. However, scholars of technology usually classify technologies as hardware, software and knowledgeware or more generally as being hard or soft.

Hardware is a physical artifact that is used in solving a problem or performing a task, whereas software corresponds to the program or set of instructions that describes the method of a task. Knowledgeware, on the other hand, is the knowledge of techniques that covers methods, materials, tools and processes. Hard technologies are usually composed of mostly hardware and include the plant, equipment such as computer numerical control (CNC) machines, and robots (Whittaker, 1990) whereas soft technologies are easier to change compared to hard technologies, and composed of software and knowledgeware (Chase and Aquilano, 1995).

Similar to the adaptation of organisms, adaptation in organizations is the process by which organizations and their participants maintain consistency in and among themselves against short-term environmental fluctuations and long-term changes in the composition and structure of their environments (Rappaport, 1971). Despite the widespread use of the term technology “adoption” in the literature, I have chosen to use the term “adaptation” since adoption implies “choosing something voluntarily, accepting it formally, putting into effect and using it in practice” (Merriam-Webster, 2006). Whereas adaptation leaves room for adjustment to local, environmental conditions and allows “to make fit for a specific or new use or situation, often by modification” (Merriam-Webster, 2006). Hence, the term adaptation is purposefully used in this dissertation to refer to the mutual adjustments in structural and agency based elements of technology in organizations.

1.1. Research Problem and Objectives

Reviewing earlier theoretical approaches to technology in organizations, the objective of this study is to develop a comprehensive understanding of how technology is experienced and the way technology adaptation unfolds in organizations. My aim is to understand how technologies are locking organizations in particular patterns of practice and at the same time, how technologies are also enacted to unlock and destabilize established practices in organizations.

In this study, I am considering technology adaptation both as structuration and institutionalization. I am considering structuration as a set of dynamic relationships historically and contextually embedded into the action realm, whereas institutionalization is understood as another set of dynamic relationships embedded into the structure realm. I call this model of technology adaptation as “Recursive Dualism of Technology” (RDT) because the structural changes may originate from either structure or action realms of technology and may propagate each other during technology adaptation since both realms are recursively implicated.

The model assumes a dynamic and highly non-linear nature due to the feedback mechanisms between action and structure realms of technology, by either supporting or undermining each other's effects. It is capable of explaining both emergent and discontinuous changes during the process of technology adaptation.

While developing a model to explain the complex web of relationships between technology and organizations, I am also interested in reviewing some ideas on living with technology adaptation in organizations but I am not offering a set of "managerial prescriptions" on how to use technology to successfully implement change.

In this study, I attempt to make three types of contributions: First, I develop a comprehensive model of technology adaptation in organizations to build on the accumulated knowledge of technology, especially the Operations Management (OM) related technologies such as Enterprise Resource Planning (ERP), Total Quality Management (TQM), Just-In-Time production (JIT) and Knowledge Management Systems (KMS) from an Organization Studies (OS) perspective. Second, the dissertation is expected to contribute to theory building in organization theory, sociology of technology, and operations management through empirical investigation of technology adaptation using the RDT model, taking into consideration both local, contingent aspects of socio-technical change and the broader social structures at the same time. Finally, the dissertation attempts to contribute to the field of organization studies by combining structuration and institutionalization processes in the RDT model to expand the understanding of social institutions and the process of construction and maintenance of a social institution.

In the rest of this dissertation, the prior approaches and models on technology in organizations are reviewed with a special emphasis on structuration and institutionalization perspectives, in Chapter 2. A limited review of organizational change literature and process of institutional change is also presented in that chapter. Structuration Theory of Giddens (1984) is reviewed with critiques and alternatives, especially those provided by Mouzelis (1995) and Archer (1982, 1989, 1995). In Chapter 3, I develop and present the RDT model together with a set of theoretical propositions that describe RDT. In the same chapter, the RDT model is further discussed in relation to Enterprise Resource Planning technologies, which is the technology under focus for the cases of this study. Research methodology and design are presented in Chapter 4. Following that, ERP adaptation case studies in different organizational situations are presented and the theoretical results and implications are discussed. In Chapters 5, 6, 7 and 8, ERP adaptation cases are presented and discussed within the framework of the RDT model. In Chapter 9, all case studies are compared and contrasted to discuss the empirical validity of the RDT model together with the limitations of this study and potential further studies.

2

LITERATURE REVIEW

In this chapter, I describe and critically reappraise the earlier literature that the RDT model is built on. Institutional approaches to stability and change are described and agency based and structural explanations of technology and organizational phenomena are discussed together with power mechanisms within organizations. I also review, structuration theory of Giddens, and present its critiques and alternatives.

2.1. Technology and Organizations

During the 1960s and 1970s rational models had dominated social analyses of technology. Over the past 25 years, researchers have developed a variety of explanations on the relationship between organizations and technology, including structuration (Orlikowski 1992, DeSanctis and Poole 1994), organizational learning (Robey et al. 2000), and actor network theory (Walsham 1997) to name a few. All these perspectives consider technology within its social context and in relation to organizational processes leading to stability and change in organizations. The desire to explain the technology and organization relationship usually leads to theoretical positions that privilege either human agencies over social structures and technological features (agency position) or social structures and technological features over human agencies (structural position) (Boudreau and Robey, 2005).

An agency position suggests that humans are relatively free to enact technologies in any way they like. Humans can devise novel uses of technologies and cause unanticipated consequences (Orlikowski and Barley 2001). For example, Orlikowski (2000) concluded that transformations in organizations were enacted by actual practices rather than caused by the structural aspects of a technology. According to this perspective, as users enact technologies in response to their local experiences and needs, significant organizational changes may result over time. Such changes are not realized from the social structures that are embodied in the technology, but rather "every engagement with a technology is temporally and contextually provisional, and thus there is, in every use, always the possibility of a different structure being enacted" (Orlikowski 2000, p. 412).

On the other hand, structural perspectives treat technology as a determinant of change and organizational action. They hold the view that technologies play active roles in creating and maintaining social order by embodying rules for action and limiting choice alternatives (Huber 1990, Zuboff 1988). Thus technologies can constrain social action in a manner similar to that of social structures. Although technologies are acknowledged to be the products of human action, they become constraints on the human agency once they are in use.

In addition to these approaches which privilege organizational action or social structure, structurational perspectives on organizations and technology try to establish a balance between them based on Giddens' (1984) structuration theory (DeSanctis and Poole 1994, Orlikowski 1992, Orlikowski and Robey 1991, Poole and DeSanctis 2004). For example, Barley (1986) considered computerized imaging technologies as "occasions" for structural changes in organizations, showing that each were enacted differently in different settings despite their similar technical features. According to this perspective, human action is not determined by social structures or technologies. As Jones (1999) argued, both agency and structure operate in both a dialectic and emergent manner, each mutually affecting and transforming the other, creating an adaptation of structure and agency:

> *The particular trajectory of emergence is not wholly determined either by the intentions of the human actors or by the material properties of technology, but rather by the interplay of the two. ... These interactions would seem particularly complex in relation to information technologies with their intangible products and their extensive involvement in a diverse range of organizational work practices (p.297).*

Despite the intended balance between structure and agency, structurational perspectives usually lead to a more agency based outlook, reducing social structures to repeating patterns in human actions and loosing institutional influences on technology adaptation. Therefore, while trying to develop the RDT model as a comprehensive model of technology adaptation, I have drawn from institutional theory and power based perspectives in addition to structuration theory.

Institutional theory explains that social conditions effectively constrain but do not completely determine human action (DiMaggio 1988, 1991; Oliver 1991). According to Van de Ven and Poole (1995) organizational change theories can be grouped into four ideal type explanations, namely life-cycle, dialectical, teleological, and evolutionary. Institutional theory represents a combination of life-cycle and dialectical explanations of organizational change. Some institutional theorists also acknowledge that "individuals and organizations can deliberately modify and even eliminate institutions" (Barley & Tolbert 1997) through choice and action, opening the theory for the teleological explanation. Structuration theory, on the other hand, is more teleological and evolutionary because it centers on purposefulness of the conscious actor and evolutionary change. In RDT, I augment institutional theory with structuration theory, aiming to develop a comprehensive and dynamic model of technology adaptation that accounts for how actions and structures are "recursively related" (Barley and Tolbert, 1997). I consider this combination unproblematic because principal tenets of institutional theory resemble the premises of structuration theory as articulated by Giddens (1976, 1979) and by those who followed structuration theory in organization studies (Barley, 1986; Manning 1982; Pettigrew, 1987; Ranson, Hinings and Greenwood, 1980; Roberts and Scapens 1985; Smith 1983; Spybey 1984; Willmott 1987).

2.2. Institutional Explanations of Stability and Change

The concept of institutions has been a concern within sociological theory (Hughes 1936, 1939; Parsons 1951; Selznick 1949, 1957). Institutions have also become a central notion in organizational research with the development of institutional theory of organizations (DiMaggio & Powell 1983; Meyer & Rowan 1977; Powell & DiMaggio 1991; DiMaggio and Powell 1983; Zucker 1977, 1983). According to Scott, "Institutions consist of cognitive, normative, and regulative structures and activities that provide stability and meaning to social behavior. Institutions are transported by various carriers – cultures, structures and routines- and they operate at multiple levels of jurisdictions." (Scott, 1995, p.33).

Institutional theorists maintain that organizations and individuals are strongly intertwined in a web of values, norms, rules, beliefs, and assumptions; some of which are beyond individual choice. The central theme of institutional theory has been to explain the isomorphism within organizational fields and the establishment of institutional norms (Covaleski and Dirsmith 1988; Galaskiewicz and Wasserman 1989; Levitt and Nass 1989; Tolbert and Zucker 1983). Institutional theory proposes that organizational environments '...are characterized by the elaboration of rules and requirements to which individual organizations must conform if they are to receive support and legitimacy...' (Scott and Meyer 1983, p. 149). Therefore, environments provide blueprints for organizing by specifying the forms and procedures an organization should take to be considered as legitimate (Meyer and Rowan 1977). Forms and procedures are derived and facilitated institutionally by normative, coercive, and mimetic forces (DiMaggio & Powell 1983).

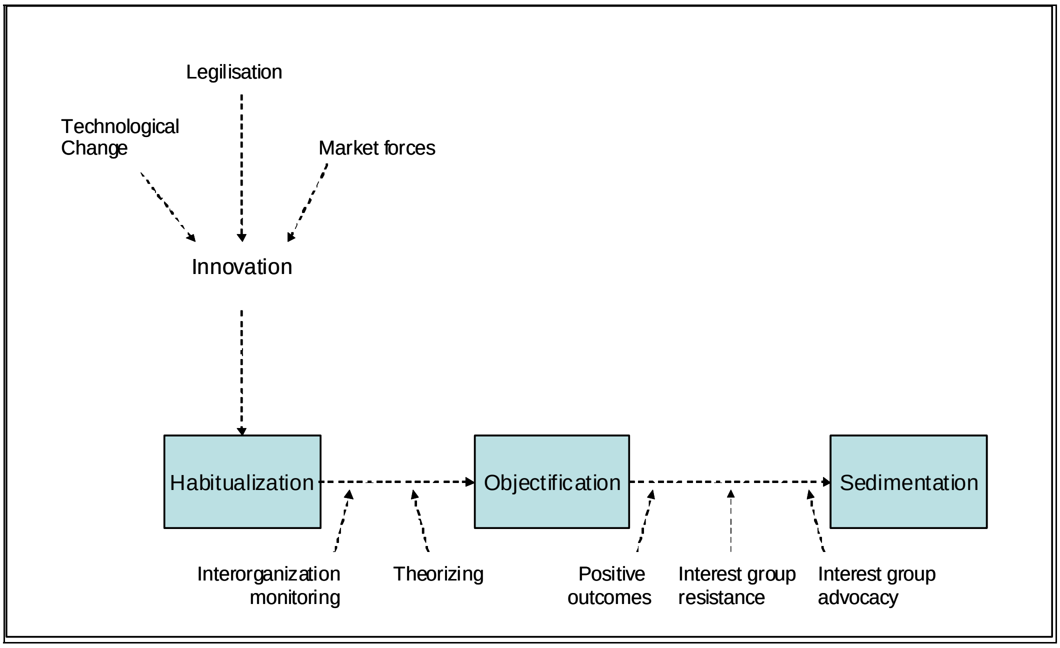
Institutions impose constraints on individual and collective actions. They, however, are open to modification and reconfiguration over time. Whether institutions are considered as cognitive, normative or regulative structures, they "must be constructed and maintained as well as adapted and changed" (Scott & Christensen, 1995, p. 303). Institutional theory has primarily focused on understanding stability, convergence and isomorphism within organizations. However recently, the dynamics of institutionalization and institutional change also have received attention (Barley & Tolbert, 1997; Dacin, Goodstein & Scott, 2002; DiMaggio & Powell, 1991; Fligstein, 1997; Greenwood, Suddaby & Hinings 2002; Hoffman, 1999; Kitchener 2002; Scott & Christensen, 1995; Seo & Creed, 2002).

Institutionalization is defined by Berger and Luckmann (1967) as a core process in the creation and maintenance of stable social groups. An institution is described as "reciprocal typification of habitualized actions by types of actors" (Berger and Luckmann 1967, p. 54) and the process that creates an institution is defined as institutionalization. Tolbert and Zucker (1996) suggest three key component processes for the initial formation and maintenance of institutions: Habitualization, objectification and sedimentation. Habitualization refers to the development of patterned problem solving behaviors with particular stimuli. Objectification, refers to the development of general shared social meanings attached to these behaviors. It is considered necessary for the transplantation of actions to contexts beyond their point of origination (Tolbert and Zucker 1996). The third process is referred to as sedimentation by Tolbert and Zucker

(1996). It is the process through which actions acquire exteriority. Extority refers to the degree that typifications are 'experienced as possessing a reality of their own, a reality that confronts the individual as an external and coercive fact' (Zucker, 1977). It is about historical continuity of typifications (Zucker, 1977) and especially their transmission to the new members who treat them as social given facts (Berger and Luckmann, 1967). Zucker (1977) demonstrated that as the degree of objectification and exteriority of an action increased, so did the degree of institutionalization. They defined institutionalization as the individuals' conformity to others' behavior. The study showed that when institutionalization is high, the transmission of the action, maintenance of that action over time, and resistance of that action to change are all also high.

Figure 1-1 Component processes of institutionalization

(Source: Tolbert and Zucker, 1996)



Regarding institutional change, existing literature mainly has two basic explanations: structural and agency based. The structural explanation suggests that change occurs when an external contradiction disrupts the existing institutional order. Change is the result of a reconfiguration process, is context dependent, and involves no particular causal agent. The agency-based explanation suggests, on the contrary, that the origin of change is in human action at the individual level (Seo & Creed, 2002; Zucker, 1988), the group level (Lawrence, Hardy & Phillips, 2002), or the organizational level (Holm, 1995). The human action leading to change may be purposeful (Barley & Tolbert,

1997) or not (Lawrence et al, 2002). Such explanations of organizational change acknowledge a rational actor, who acts mostly independent of his context, which is, as an argument, controversial to the sociological foundations of organization studies and institutional theory in particular.

A major contribution to the processual understanding of institutional change is provided by Barley and Tolbert's (1997) conceptual model. Since Giddens' perspective is implicitly temporal (Burns and Scapens 2000), Barley and Tolbert (1997) redefined structuration as a processual model that describes the relationship between agency and structure over time and made a theoretical attempt to combine the institutionalist perspective with structuration theory. Similar to this study, they do not conceive structure and agency as a conflated duality, but as rather two distinct recursively linked realms. According to Barley and Tolbert (1997), institutions are encoded in scripts and actors enact these scripts in practice to replicate structures and develop new structures by revising them. The revised scripts are further externalized and objectified to form the behavioral regularities that are "observable, recurrent activities and patterns of interaction characteristic of a particular setting" (Barley and Tolbert, 1997, p. 98).

2.2.1. Power and Institutions

During technology adaptation in an organization, power based institutionalization mechanisms are expected to operate. The needs and goals of different agents, (Cyert, Dill, & March, 1958) or orientations of different structures (Mouzelis, 1995) may inevitably conflict or contradict. In organization studies, existing perspectives of power mostly focus on forms of power "as ... manifested in willful acts of influence" (Lawrence, Winn and Jennings 2001) in relation to hierarchical relationships within a collective of individuals. However, institutionalization and structuration of a technology in an organization involves a variety of agents and structures. Hence, consideration of a broader range of power forms (such as incarceration, violence, surveillance, examination, discrimination, processual domination, etc.) is necessary. Lawrence, Winn and Jennings (2001) propose a typology of power-based mechanisms that can support development and maintenance of institutions. Their typology categorizes "power-based institutionalization mechanisms" according to the dimensions of whether the source of power is agency (episodic) or structural (systemic) and whether the target of power acts as an object or a subject. If the target has no ability to choose, then the source is omnipotent, completely in control over the target's future whereas, if the target has the ability to choose, then it always has some potential to act otherwise. Based on these differences, their typology is categorized into four power based institutionalization mechanisms (See Figure 2.2.) that have been extensively examined in the literature: influence, force, discipline, and domination (Lawrence, Winn and Jennings, 2001). Influence is identified as agency-based power exercised on subjects who have the ability to choose. If power is exercised by an agency-based source and the target has to obey the source, than the mechanism is identified as a force. If the source of power is structure-based and the target has capacity to choose, the power-based mechanism that operates between them is discipline. If power from a systemic source acts on objects with no choice, then the mechanism is called domination. Lawrence, Winn and Jennings (2001) proposed that pace and stability of an institutionalization process is related with the degree and nature of inherent power mechanisms employed. Their typology is valuable for my study since it differentiates between structure and action based sources of power and, unlike most accounts of power in the literature, takes into consideration the capacity of the power source in determining the target's future. The mechanisms described in this typology enable us to locate different power-based mechanisms applicable to the different processes operating between structures and actions during technology adaptation.

Figure 2-2 Power Mechanisms in Institutionalization

Source: (Adapted from Lawrence, Winn and Jennings, 2001)

Source		Target: Choice	Target: No Choice
	Agency	Influence	Force
	Structure	Discipline	Domination

2.3. Structuration of Stability and Change

Although "structuration" as a term is generally used to refer to the formation of social structures, it is predominantly used in the structuration theory (Giddens, 1984). Structuration theory attempts to resolve the deep-seated ontological division in the social sciences between paradigms and has offered a way out from the impasse. It was developed (Giddens, 1976; Giddens, 1979; Giddens 1984) as an attempt to resolve the fundamental division in the social sciences between the naturalistic and interpretive tradition. By incorporating both subjective and objective interpretations of the world, Giddens proposed a view of human agents and social structure as a mutually interdependent duality rather than a dualism. In other words, instead of seeing human action taking place within the context of the 'outside' constraints of social structure (a dualism), action and structure are seen as two aspects of the same whole (a duality).

According to Giddens, structuration refers to the "formation and maintenance of social structures and systems by conceptualizing the relation between the subjective powers of the actors and the objective powers of the social structures they produce" (Parker, 2000). According to Giddens, humans are essentially involved within society: they actively construct, support, and change it. While humans are affected by society they also affect it. They are capable of resisting imposed constraints However, as Layder (1994, p. 128) says "Giddens is careful of not stepping in the foot print of the ethnomethodologists or phenomenologists who do not recognize the existence of society beyond every day life and recognize that social institutions pre-exist individuals".

Regular actions of knowledgeable and reflexive agents establish patterns of interaction that become standardized practices. Habitual use of standardized practices becomes institutionalized forming the structural properties of organizations and societies. Structure is the rules and resources that constitute the structural properties of social systems. Giddens defines structure as "rules and resources recursively implicated in social reproduction; institutionalized features of social systems have structural properties in the sense that relationships are stabilized across time and space". (Giddens 1984). Structure "exists only as memory traces, the organic basis of human knowledgeability, and is instantiated in action" (Giddens 1984). Giddens regards structure not merely as constraining, but also as enabling. "The structural properties of social systems are both medium and outcome of the practices they recursively organize" (Giddens 1984).

Structuration refers to the conditions governing the continuity or transformation of structures, and therefore their reproduction. It is an ongoing process rather than a static property where the duality of structure evolves and is reproduced over time space. Agents in their actions constantly produce and reproduce and develop the social structures, which both constrain and enable them. "All structural properties of social systems … are the medium and outcome of the contingently accomplished activities of situated actors. The reflexive monitoring of action in situations of co-presence is the main anchoring feature of social integration" (Giddens, 1984, p. 191).

Giddens also draws the attention to the notion of power. Although human action is motivational and intentional, motivation and intention are not prime causes of action. According to Giddens, all human action implies power—the capacity to produce an effect (Layder, 1994, p. 137). Giddens is very concerned regarding to the unequal distribution of power. The extent of one's influence is limited by the resources at her/his disposal. However, he believes that even subordinates will have some resources at their disposal to balance the power relationship (Layder, 1994, p. 137).

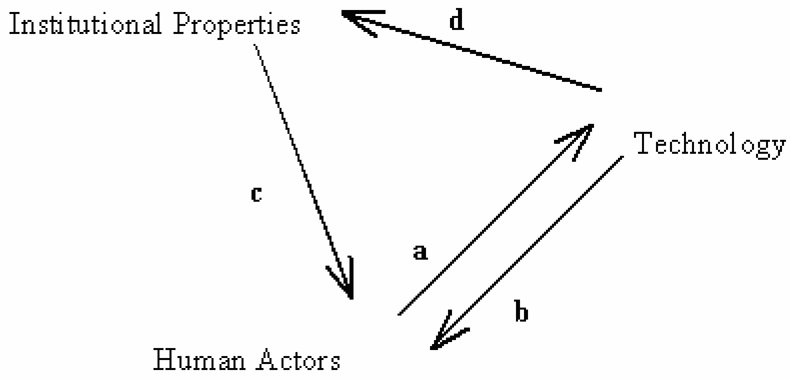
Giddens points out that structuration theory does not carry any particular methodological implications but *sensitizes* the researcher to particular concepts, such as the relationship between action and structure, which might otherwise be ignored. Giddens' work on structuration has received considerable attention from many fields including organization studies and information technology (Jones 1998).

2.3.1. Structuration of Technology

Orlikowski (1992) has reconsidered the various conceptualizations of technology in the literature and building on structuration theory, suggested a *structurational model of technology*. The model is based on the notions of *the duality* and *interpretive flexibility of technology* and proposes that human actions are both enabled and constrained by technology, yet technology exists as a result of previous actions of human agents (See Figure 2-3).

The duality of technology aims to eliminate the dichotomy between the objective view of technology as "hardware", equipment, machines, and instruments and the social view of technology (Barley, 1986; Davis, Bagozzi and Warshaw 1989). According to this view, any technology has both an actual component such as a material artifact and a social component such as a meaning that actors attach to a technology.

Figure 2-3 Structurational Model of Technology (Source: Orlikowski, 1992)



Arrow	Type of Influence
a	Technology as a product of human action
b	Technology as a medium of human action
c	Conditions of interaction with technology
d	Consequences of interaction with technology

A consequence of the duality concept is the interpretive flexibility of technology, which means that the interaction of technology and organization is a function of the different actors and socio-historical contexts in technology design and use. Instead of seeing design and use as disconnected stages in the life-cycle of a technology, the structurational model of technology argues that users can change a technology actually and socially through their interactions –interpret, appropriate, and manipulate it in various ways– under the influence of various social and individual factors. Orlikowski (1992) suggests that both opportunities for change, as well as rigid and routinized views of technology often develop as a function of the interaction between technology and organizations. She argues that they are not embedded into the nature of the technology. Therefore, human agency can shape technology and also get shaped by it.

Orlikowski later developed a practice-based action perspective on the organizational change issue which she calls "Situated Change Perspective", building more on the action side of the structuration theory (Orlikowski, 1996). She questions the belief that organizational change must be planned, and technology is the primary cause of technology related organizational transformation, and radical changes always occur rapidly and discontinuously. She focuses on changes in the on-going practices of individuals. Orlikoswski (1996) criticizes the punctuated equilibrium models where the change is rapid, episodic, and radical for being still based on the primacy of structure and suggests that extant perspectives neglect "emergent change", where the realization of a new pattern of organizing establishes without prior intentions. She considers organizational transformation as an on-going improvisation enacted by organizational actors trying to make sense of and act coherently in the world. She considers organizational design as emergent phenomena that become only visible after the fact. According to this perspective, each change in practice creates the conditions for further breakdowns, unanticipated outcomes, and innovations. Organizations are considered as enacted creatures that are constituted by the ongoing agency of actors. Actions either reproduce existing organizational properties or alter them (Orlikoswski, 1996).

Because the structuration theory has an abstract formulation, its empirical application has been a rare event (Barley and Tolbert, 1997). Thrift (1985) and Gregson (1989) even claimed that the structuration theory is empirically irrelevant. Hence both the duality of technology model and the related empirical tests (Orlikowski & Gash 1994; Orlikowski 1993) are critically important for the structuration theory.

2.4. Critics and Alternatives of Structuration

A number of criticisms, which also apply to most of the other studies that take a structurational perspective, have been posed against structuration theory. First, some critics charge that structuration theory conflates action to structure, structure to action (Clegg 1989; Archer 1982, 1989, 1995; Layder 1987; Callinicos 1985; Mouzelis 1995). If we deny the existence of structure apart from action, how can we empirically investigate them separately? If action and structure are not analytically and phenomenologically distinct, which induces change or leads to order and stability? The structurational perspective has also been criticized since it assumes that any organizational intervention can be interpreted and appropriated relatively independent of the constraining effects of the social structure. How and where structuration constrains and enables action is also ambiguous. Walsham (1997) notes that Giddens' work offers few methodological guidelines, making it difficult to answer some important questions such as why one technology is successful while another is not. Furthermore, structuration theory is difficult to apply empirically, since it is a meta-theory which remains fundamentally non-propositional.

Mouzelis (1995) and Archer (1995) offer alternatives to the structuration theory. While Mouzelis provides an internal critique and reconstruction of Giddens' theory, Archer provides a distinct, external alternative. However, both authors reintroduced the dualism of agency and structure to avoid the pitfalls of the duality concept (Healy, 1998). In the following sections, I will consider these critics and alternatives.

2.4.1. Reconstruction of Structuration

Mouzelis (1989, 1995) considers the reduction of the structure-agency dualism into a duality as incomplete. "The type of subject-object relationship that the duality-of-structure scheme implies does not exhaust the types of relationship subjects have vis-à-vis rules and resources, or towards social objects in general" (Mouzelis 1995, p. 119). He introduces the paradigm-syntagm distinction to differentiate general rules (paradigm) from their specific instances (syntagm) (Healy, 1998).

According to Mouzelis, the actors' orientation may change depending on their situation: they "may unthinkingly enact rules (paradigmatic duality) or contemplate them (paradigmatic dualism); or consciously deal with it as a game (syntagmatic duality) or be powerless to affect it (syntagmatic dualism)" (Healy, 1998, p. 511). These alternative orientations do not eliminate either duality or dualism concepts but consider both of them simultaneously.

Mouzelis (1989, 1995) also proposes that an individual's orientation depends largely on his/her position in the social hierarchy. Thus, agents who are higher up in the hierarchy influence agents at lower levels "by creating both limits and opportunities for them" (Mouzelis 1995, p. 142). Decisions therefore taken by a macro actor may establish lower level structures for meso and micro actors creating limits for their actions, whereas issues that can be considered as external for a micro actor might be more malleable for a meso or macro actor, as described by Mouzelis (1995, p. 120-1):

> *Occupants of subordinate positions tend to relate to games played at higher organizational levels in terms of syntagmatic dualism (since as single individuals they cannot affect them significantly); whereas they relate to rules initiated from above predominantly in terms of paradigmatic duality (since they are supposed to, and often do, follow them in a taken-for-granted manner). The opposite combination (syntagmatic duality and paradigmatic dualism) obtains if one looks at*

how occupants of super-ordinate positions relate to games and rules respectively on lower organizational levels.

Mouzelis' argument suggests that both structures and actors exist simultaneously at different levels. "Talk about micro-macro, or about participant-social-whole linkages without taking into account social hierarchies is like trying to swim in an empty pool" (Mouzelis 1995, p.126). Since all complex social wholes, including organizations, are hierarchical, an orientation of an individual to system or rules which depends largely on her/his position in the hierarchy. Thus, "whenever games are hierarchised, players higher up influence games and players at the lower levels by creating both limits and opportunities"(Mouzelis 1995, p.142). So, "what is an external and non-malleable game from the perspective of a micro or meso actor, may be less external, and more malleable from the point of view of a macro actor" (Mouzelis 1995, p. 141). According to Mouzelis, "actor" can be an operational team member of a company (micro) or a branch manager (meso) or the company president (macro) whose decisions directly affect all other people in the company. Mouzelis (1995) suggests that institutional structures and actors exist at different levels with different powers and reaches. Therefore, macro-actors can have a strong influence on the local conditions of micro-actors. Mouzelis (1995) also suggests that, similar to the multi-level nature of actors, institutions are also constructed and maintained to varying degrees of "durability" (Mouzelis 1996). The variation in durability of institutions does not come from their "materiality" or weakness, but from the fact that, "on the level of social integration, powerful interest groups support them more or less purposely" (Mouzelis 1996, p. 3). Therefore, unlike Giddens, Mouzelis (1996) can classify power and durability variations within a social hierarchy. Considering that some structures are much harder to change than others, and actors' orientation vary on the basis of their position, is a significant improvement, to get an empirical leverage on a problem (Healy, 1998).

2.4.2. Morphogenetic Approach

Archer (1995) argues that conflating structure and action in the Structuration Theory not only weakens the concepts analytically but also challenges the distinction between original concepts ”social” and ”system” integration by Lockwood (1956, 1964), which she considers as necessary to be able to understand why things are ”so and not otherwise”. According to Archer (1995), structure and agency are ”phased over different tracts of time". Human actions are effective over the short term whereas structures are clearly more enduring, which also allows their analytical separation. She considers Giddens' conceptualization of structure as "rules and resources" in memory traces of individuals that are -instantiated in action, as loose and abstract. In this sense, Archer (1995) is closer to the structuralist tradition of social thought, whereas structure has a far more tangible function in constraining human action. Thus Archer (1982) argues that Giddens undermines structures' very nature of being "a priori" and autonomous.

In the light of these criticisms, Archer (1995) develops the morphogenetic approach to provide an alternative to structuration theory. The term "morphogenesis" refers to social processes that alter or change systems, given state or form (Buckley, 1967). She conceptualizes change as a socio-historical interplay of structure and agency as a historical process. According to Archer (1995), actors influence social structures through their daily activities. However, their degree of influence depends on their position in society and their resources. Therefore, Archer (1995) accepts we all, more or less, have the ability to affect social structures. However this depends on the specific context that we were born or find ourselves in at any given point in time.

Archer (1995) posits that, social structures are the product of human interaction, but they can act to constrain or enable individuals who then reproduce or transform the structural arrangements by their actions. Structures therefore are dependent upon actors, but due to their own causal capacity can be considered as apart from human agency that had created them. In other words, structures have their own ability to cause things to happen, hence they are real entities enduring through time and space, following the philosophical realism of Bhaskar (1989).

According to Archer (1995), actors do not actively construct social reality everyday; rather they are born into an existing social order. Therefore, unlike structuration theory, Archer's perspective proposes that social structures exist prior to action. Therefore, Archer (1995) notes that structuration theory ignores the fact that although people create and re-create the social structure they live within, they are always born into existing structural arrangements. However, Archer (1995) does not implicitly mean to legitimize the status-quo, instead, being able to analytically define it, she suggests asking more fundamental questions, regarding to the existing state of relations and structures. For example, Archer(1995) considers the structuration theory's conceptual explanation of reproduction of social structure as insufficient to explain why we have to be in the system that we are in the first place. A more crucial question according to Archer is: "why do some forms of social reproduction succeed and become institutionalized, and others do not?"(Archer, 1995). A similar question in technology domain might be 'why does one technology become institutionalized in organizational life, and another does not?'. For such questions, Archer (1995) argues that the structuration theory has no direct answers.

Archer (1995) uses *social integration* (state of relations between actors) and *system integration* (state of relations between social structures) concepts (Lockwood, 1964) to explore the necessary level of interaction for the creation of a favorable or an unfavorable condition for social change. She asserts that the sufficient impetus for change must exist at both social and system integration levels to have enduring social change.

2.5. Combining Structuration and Institutionalization

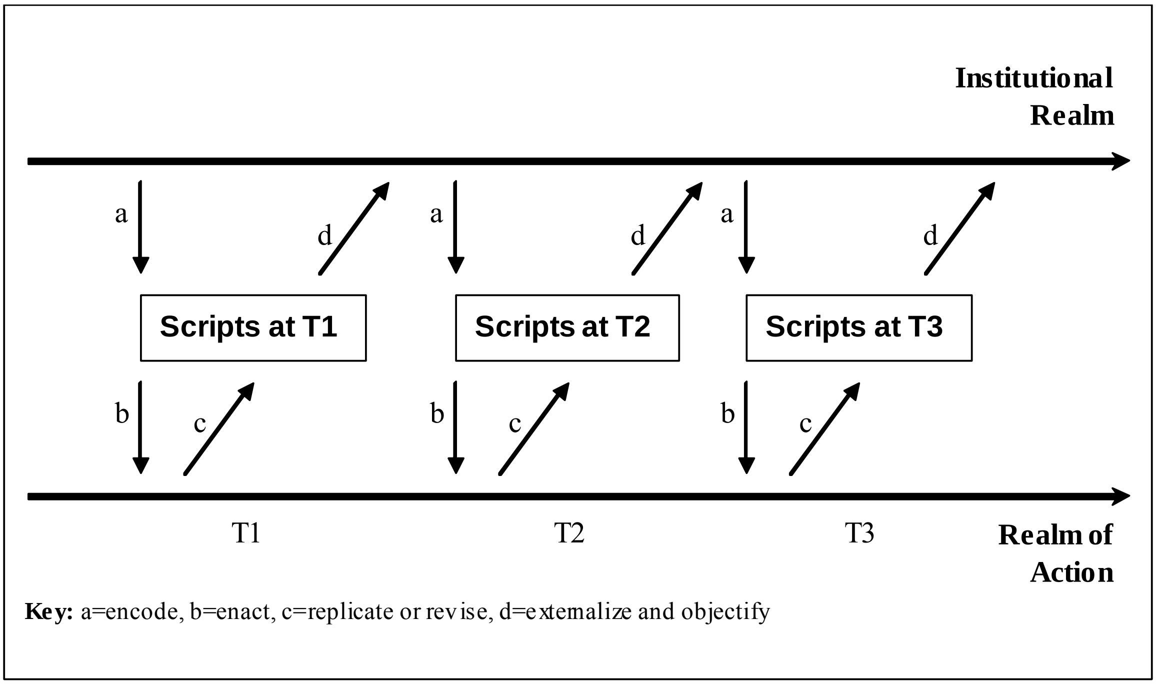
Arguments of structuration theory as articulated by Giddens (1976, 1979) and those who worked with the ideas of structuration in organization studies (Ranson et al. 1980; Pettigrew 1985,1987; Willmott 1987) bear a resemblance to some of the tenets of institutional theory. Like institutional theorists, structuration theorists acknowledge that social conditions significantly constrain but do not completely determine human action. Although it is not as frequent, "individuals and organizations can deliberately modify, and even eliminate, institutions" (Barley and Tolbert 1997) through choice and action. As suggested by Barley and Tolbert (1997), structuration theory may augment institutional theory to develop "dynamic models of institutions and devise methodologies for investigating how actions and institutions are recursively related".

An attempt to combine institutionalization and structuration is provided by Barley and Tolbert (1997) in their recursive model of institutionalization based on Giddens' concept of structuration (Figure 2.4) to explain the dynamic interaction between institutions and human action. Since Giddens' models do not incorporate historical time (Burns and Scapens 2000) and are implicitly temporal, Barley and Tolbert (1997) translate Giddens' static portrayal of structuration into a more dynamic model that describes the relationship between agency and institutions over time. They also discussed methodological requirements of studying institutionalization as structuration. With regard to day-to-day interactions, they perceive institutions as being enacted through "scripts" (Barley 1986). They define scripts not primarily as cognitive phenomena (Schank and Ableson 1977) but as behavioral regularities. From their perspective, scripts are observable and recurrent activities, and patterns of interaction characteristic of a particular setting. Their version of “scripts” encode the social logic of what Goffman (1983) called an “interaction order”.

Their model combines institutionalization with structuration and considers it as a continuous process whose operation can be observed only through time. The distinct horizontal arrows signify the temporal extensions of Giddens' two realms of social structure: institution and action. The vertical and diagonal arrows linking the two realms denote the recursive dualism of social systems. Since their model no longer conceives structure and agency as a dual whole but rather two distinct realms, it is the reintroduction of dualism in a recursive manner instead of duality. Vertical arrows represent ”institutional constraints on action”, while diagonal arrows represent ”maintenance or modification of the institution through action”, that is, dualism of social systems. According to the model of Barley and Tolbert (1997), ”social behaviors constitute institutions diachronically, while institutions constrain action synchronically”.

Figure 2-4 A sequential model of institutionalization

(Source: Barley & Tolbert 1997)



The first arrow (a) represents the encoding of institutional principles in the scripts used in specific settings. It frequently takes place during socialization and involves an individual internalization of rules and interpretations of behavior appropriate for particular settings.

The second arrow (b) occurs when ”actors enact scripts that encode institutional principles”. Enacting a script may or may not entail conscious choice or an awareness of alternatives. In many cases enactment does not involve awareness or intention: ”actors simply behave according to their perception of the way things are”.

The third arrow (c) is about the degree to which behaviors revise or replicate the scripts. Usually an attempt to alter scripts is more likely to lead to institutional change than are unconscious, unintended deviations from a script (see Boisot and Child 1988). Changes in technology, cross-cultural contacts, economic downturns, and similar events increase the potential that actors will realize that an institution should be modified (Ranson et al. 1980). However, their ability to apply change is likely to be constrained by the inflexibility that got disturbed by the change in the status quo. Those people are likely to resist change in an existing set of arrangements (Pettigrew 1987). Thus, Barley and Tolbert (1997) believe that contextual change is usually necessary before actors can assemble the resources and rationales that are necessary for collectively questioning scripted patterns of behavior. Otherwise idiosyncratic deviations from scripts occur but they are apt to have only passing impact on social arrangements.

The fourth arrow (d) represents the objectification and externalization of the patterned behaviors and interactions produced. This involves the disassociation of patterns with particular actors and particular historical circumstances: the patterns acquire a normative, “factual” quality.

Studies on the structuration can complement models of institutionalization. As suggested by many prior studies on technology adaptation, as time passes, technology tends to become taken-for-granted in use. The significant insight of this work is that the process of this dynamic interplay between the action and structure is understood as institutionalization and structuration.

2.6. Enterprise Resource Planning Technology

In order to empirically observe the model, I have selected Enterprise Resource Planning technology to be the case technology to study empirically in organizational settings. Enterprise Resource Planning (ERP) is a complex software technology that integrates business processes in organizations such as financial administration, human resource management, manufacturing, and supply chain management around a common database. Since ERP is a ready-made software solution, it allows limited modification during its design, implementation, and use in an organization and poses limits on organizational action (Kallinikos 2004, Robey et al. 2002). Fundamental modifications on the work processes embedded in the vendor's software are discouraged and plain implementations are recommended (Robey et al. 2002). The integrated nature of an ERP system imposes more constraints on its users, as their work is tightly coupled with this highly integrated software and limits users' enactments.

Implementation of an ERP system is reported to be challenging, typically taking one to five years and with significant costs (Mabert et al., 2000). Despite investing significantly in time and resources, many companies have struggled and sometimes failed in ERP adaptation (Mabert, Soni and Venkataramaan 2000; 2003). Considering the issue as a planned organizational change attempt, this is not surprising because theorizing and practicing change in organizations are among the most challenging issues in management theory and practice. Therefore, organizational changes experienced during design, implementation and use of ERP that interact with the various facets of an organization are expected to be problematic. The difficulties organizations face during this complex and resource intensive implementation process also suggest the need for developing a better understanding of ERP adaptation in organizations (Bradforda and Florin, 2003; Krumbholz and Maiden, 2001; Rajagopal, 2002).

Adaptation in organizations is the process by which organizations and their participants change to maintain consistency in and amongst themselves against short-term environmental fluctuations and long-term changes in the composition and structure of their environments, like adaptation of organisms (Rappaport, 1971). There are many approaches that attempt to understand the patterns and mechanisms of organizational change and adaptation as technology changes. For example, despite views of gradual adaptation, Tyre and Orlikowski (1994) suggest that the pattern of adaptation for an individual new technology is often "lumpy" or episodic and highly discontinuous.

Since ERP has generic functionality sets related to specific business processes, its adaptation requires disruptive organizational change in their implementation (Asbrand, 1998; Edmondson, Baker and Cortese, 1997; Filipczak, 1997; Hecht, 1997; White, Clark and Ascarelli, 1997). The main challenge of ERP implementation is not about configuration of the technology and setting off the appropriate control parameters. ERP is a software application and therefore its inherent design imposes certain constraints on the design, implementation, and use. There are usually gaps between the software's generic functionality and the way the organization currently operates (Soh et al., 2000). When built-in functionality cannot be configured to exactly match the way the organization works, organizational processes need to be adapted to fit the basic procedures embedded in the software. If the gap between desired/existing functionality and ERP functionality cannot be bridged, then certain processes may be handled outside the software, the base code may be changed, or additional modules can be developed. Therefore, ERP implementation requires a comprehensive understanding of the critical organizational processes, and a detailed knowledge of the very complex ERP software.

The ERP concept was developed to integrate isolated systems and business processes to allow information sharing and real-time transaction functionality across business units and locations. However most of the available ERP related research tends to view ERP only as software rather than a *concept*. Furthermore most ERP research related to ERP adaptation only targets performance related issues such as cost, time, and success usually in an atheoretical manner, using mostly exploratory surveys. However, when ERP is being investigated, it is critical to make a clear distinction between the ERP concept and the ERP system and develop a comprehensive understanding of both (Jacobs and Bendoly, 2003). For example, Mabert, Soni and Venkataraman (2000) present a concept-based definition of ERP as the ”seamless integration of processes across functional areas with improved workflow, standardization of various business practices, improved order management, accurate accounting of inventory and better supply chain management”, whereas they perceive the ERP system as a software vehicle that provides this desired functionality.

Based on this distinction between the ERP concept and the ERP system Jacobs and Bendoly (2003) identify two broad streams of ERP research. They state that ERP concept research tends to focus more on the potential impact of ERP on the performance of various business functions. In contrast, ERP systems research tends to focus on the intricacies of the application and process design to meet conceptual objectives. Research on ERP adaptation is reported to fit predominantly in the second category (Jacobs and Bendoly, 2003).

Having reviewed theoretical approaches to institutionalization and structuration and research on ERP technology, in the next chapter I develop and present the RDT model, first in general terms, than specifically for ERP technology.

3

THE RECURSIVE DUALISM OF TECHNOLOGY

In this chapter, I develop and present the Recursive Dualism of Technology (RDT) model including a set of theoretical propositions regarding to the processes explained by the RDT model. In developing the model, I primarily reconsider the duality of technology model of Orlikowski (1992) and the sequential model of institutionalization and structuration by Barley and Tolbert (1997) to address both action and structure based aspects of technology. Both models are built on structuration theory (Giddens, 1984) the fundamental premises of which have been criticized by several researchers (Archer 1982, 1989, 1995; Callinicos 1985; Layder 1987; Mouzelis 1995) as discussed in Chapter 2. In one of the authoritative criticisms of structuration theory, Archer (1982, 1989) reminds that people are always born into already existing structural arrangements resulting in the primacy of structure over action. Archer emphasizes that structure may well be the medium and outcome of human action, but in the concept of duality structure doesn't have an existence outside human action although it has real consequences for agency prior to inception. Considering these critics, I introduce the concept of *recursive dualism* and reflect on the distinct effects both structure and action may have on the technology adaptation process in organizations.

3.1. Recursive Dualism of Technology Model (RDT)

In the RDT model technologies are identified as social institutions, comprised of two distinct realms: namely, structure and action. These two realms are recursively implicated in a "recursive dualism". Recursive dualism assumes a fundamental distinction between the action and structure realms considering them as two ontologically separate entities that are irreducibly distinct. However, it also acknowledges that both realms are recursively linked where each instance of one is related to a preceding instance of the other.

In the RDT model, the structure realm covers all elements that virtually govern organizational practices in the action realm. However, the structural realm is both dependent upon and has direct consequences on the action realm, due to its own "causal capacity" (Archer, 1995). In this sense, the action realm is disposed but not predetermined by the structure realm in time and space.

If elements in the action realm are to be sustained or reinforced over time, the existing or emergent structures must support them. In the absence of this condition, they would eventually fade away and be abandoned. Similarly, structural elements tend to perish if action elements do not back them. The strength of the supportive relationship between structure and action elements determines stability. The weakness or discontinuity of mutual support may lead to institutional decay or the deinstitutionalization of the existing order (Greenwood, et al. 2002; Jepperson 1991; Scott 2001) or to impermanency of the changes in action and structure. However this does not mean that the structure realm of technology is completely malleable by the action realm. The structure realm of technology has a primacy of existence over action (Archer, 1995) and enables agency "not by imposing a single and mechanical functionality but by inviting or excluding agency in special courses of action" (Kallinikos, 2002).

The hierarchical variability of agency allows some actors to have differential levels of power because of associations, positions in hierarchies, and orientations to rules and resources (Mouzelis 1995). Represented by the layers in the structure and action realm elements, such power asymmetries among different actors and structures are explicitly considered in the RDT model. Following Mouzelis (1995), agency and structure are considered to vary at three hierarchical levels, termed macro, meso, and micro. A certain macro actor or groups of macro actors, (i.e. top managers, technology officers) have the power to design the technology while meso actors (i.e. implementers, engineers) are responsible for implementation, and micro actors (i.e. users) for the use of that technology.

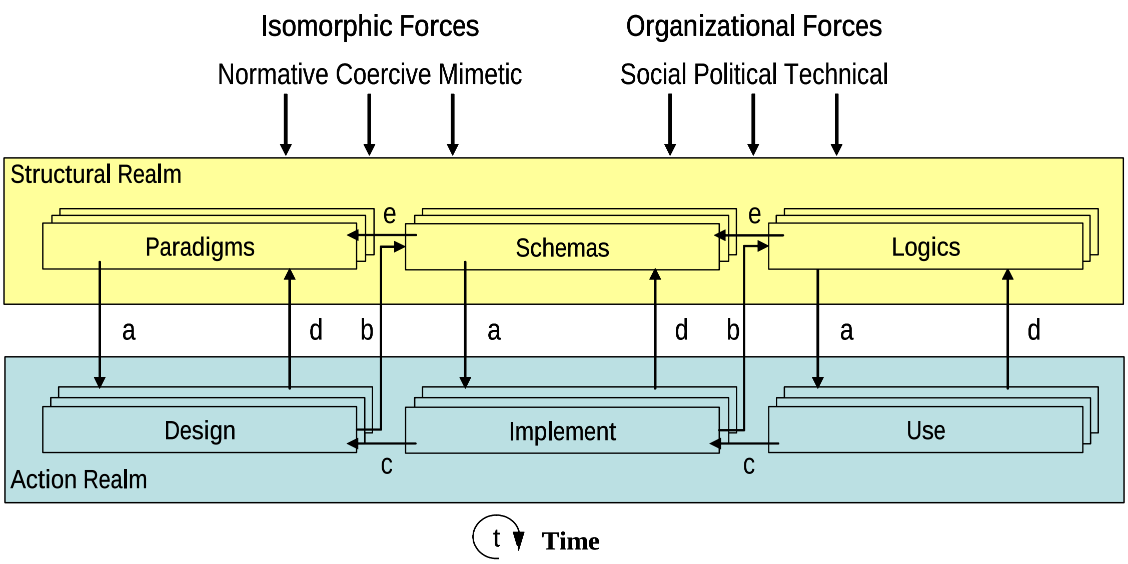
The RDT model explains technology adaptation in an organization based on two separate but interacting realms: a structure realm that consists of paradigms, schemas, logics; and an action realm that consists of design, implementation, and use. The interplay of these distinct elements at three hierarchical levels and their relationship with external structural forces depict technology adaptation in organizations over time (See Figure 3.1).

Elements in the structural realm are “shared rules and typifications that identify social actors and their appropriate activities or relationships” (Barley and Tolbert 1997; Giddens 1984; Sewell 1992). They may have normative, regulative, and cognitive natures in providing stability and meaning to elements in the action realm. The normative nature implies "normative rules that introduce a prescriptive, evaluative, and obligatory dimension into social life" (Scott, 1995, p. 37). Being regulative involves the presence of "explicit regulative processes: rule-setting, monitoring, and sanctioning activities" (Scott, 1995, p. 35) and the cognitive nature covers “the rules that specify what types of actors are allowed to exist, what structural features they exhibit, what procedures they can follow, and what meanings are associated with these actions” (Ruef and Scott 1998).

Paradigms refer to the underlying shared philosophies and general conceptions that define a specific technology, its domain of application, organization of knowledge regarding to its functions and experience in its artifacts. Paradigms are available in the institutional environment and are inscribed into actors by their professional memberships and their formal as well as informal interactions with a technology. They encompass a set of standards, obligations, and expectations, which implies moral commitments and codes of conduct. Design involves making basic governance decisions by macro actors, such as designers to outline how technology should be defined for the organization. Meso actors implement schemas of technology created in design and create technology artifacts that initiate and influence daily practices related with a technology in a specific organization. Users draw on their embedded knowledge, assumptions, experiences, and rules (Orlikowski and Robey 1991; Orlikowski 2000) from the logics of their technology practice (Bourdieu, 1990). Logics refer to the knowledge, assumptions, experiences, and rules that are inscribed in users and govern a specific technology use. The term includes the implicit or explicit judgments of micro actors on possibilities and constraints of a particular setting. Logics structure technology use similar to the way on which paradigms and schemas structure design and implementation, but logics are highly contextualized for the particular conditions of the organization. Use refers to how technology is employed, interpreted, and re-interpreted on a day-to-day basis by different actors as well as the likely conditions and consequences associated with technology use. Use also involves changes and modifications through conscious and unconscious deviations by actors.

Following the tenets of new institutionalism (see Meyer and Rowan, 1977; Zucker, 1977; DiMaggio and Powell, 1991), cognitive nature of paradigms, schemas, and logics provide the basis on which normative and regulative features are constructed. Therefore, these elements have both a cognitive (Schank and Ableson 1977) and behavioral nature, possessing regulative and normative characteristics. Hence, technology related rules, laws, sanctions, related certifications, accreditations, and the corresponding prevalent isomorphisms (Scott, 1995) are all part of different structural features of paradigms, schemas, and logics.

Figure 3-1 Recursive dualism of technology model



a = dispose **b = contextualize** **c = conflict** **d = modify** **e = contradict**

Formation and maintenance of systems integration between the elements of the structural realm give rise to the legitimacy of a technology within an organization and defined as "a condition reflecting cultural alignment, normative support, or consonance with relevant rules or laws" (Scott, 1995, p. 45) to reach expedience, become a social obligation, and have a taken-for-granted status within an organization. Hence, the prevalence of a high level of systems integration between elements in the structural realm can be an indicator of the gained legitimacy and institutionalization of a technology in an organization.

The RDT model portrays technology as the medium and the product of the relationship between human agents and the social structure. In this respect, I am in agreement with Barley (1986, 1990) who stated that: “Technologies do influence organizational structures in orderly ways, but their influence depends on the specific historical process in which they are embedded". Therefore, technology cannot be the mere cause, but a trigger of change in action and structure realms.

In their model, Barley and Tolbert (1997) uses the term "scripts" as pivots between institution and action to maintain their duality and to explicate actor's inferences regarding to the regularities in his/her actions. However, this conception of duality does not apply in the same manner in the RDT model. It reintroduces the concept of dualism by acknowledging the separate existence of structure and action realms and represents their recursive relationship through their interactions.

The RDT model also argues that some technical and social aspects of a technology are socially constructed within its local context for a specific time period, whereas some other technical and social aspects remain similar across all times and contexts. Hence, unlike Barley (1986, 1990), the RDT model enables us to understand both the social and physical modification of a technology during its design, implementation, and use.

The RDT model employs the typology of Lawrence, Winn and Jennings (2001) to locate the expected power mechanisms and considers influence, force, discipline, and domination as fundamental power mechanisms that operate between levels of actors and structures while describing the power processes between the elements of the RDT model. I expect fundamental differences in the power mechanisms pertaining to technology adaptation, depending on whether technology is classified as hard or soft (Aggarwal, 1995). Since hard technologies tend to be designed, implemented, and used more strictly, they are considered to have a dominating impact on the way that individuals work with the technology. The "black box" nature of a hard technology creates lower interpretive flexibility whereas, soft technologies are more open to interpretation by several actors. Hard technologies are more systemic in nature and therefore have fewer contradictions between their structural elements. In contrast, soft technologies are less systemic and have more potential contradictions within their structures. Therefore, I argue that hard technologies require higher levels of system integration and are more dominating on actors, compared to soft technologies, which, with their lower levels of system integration, are less dominating but more disciplinary on the way individuals work with technology.

In the following sections, I present theoretical propositions of the RDT model to describe how structures and actors at various levels in the associated organizational context, dispose, contextualize, conflict, modify and contradict with each other.

3.1.1. Organizational Context

According to RDT, structural forces in the wider and immediate environment are expected to influence the aspects of interaction between technology and organization. These forces may create a tendency for or inertia against change during technology adaptation. If they are in partial or in complete contradiction with some arrangements, this may create an impetus for change at the system integration or social integration levels (Archer, 1979; Lockwood, 1964). Forces originating from the wider organizational environment are called *isomorphic forces* whereas forces more directly attributed to specific organizational conditions are called *organizational forces* in the model.

Isomorphic forces are coercive, normative, and mimetic forces as described by DiMaggio and Powell (1983, 1991). A coercive force such as a legal obligation may force an organization to employ a certain reporting system and hence adopt a certain technology, whereas a normative force originating from an organization's memberships and associations may create a general expectancy among others to adopt a specific technology. On the other hand, if a technology is widely used in a specific industry or organizational field, this use may impose a mimetic force on other organizations, which are not users yet.

Proposition 1: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with the normative, coercive, and mimetic forces in the wider environment.

Unlike institutional forces, organizational forces originate from the primary context of a technology, that is, an organization itself. They are often linked with the wider organizational environment; however, they may be quite different across various organizations even in the same organizational field, due to their levels of diffusion (Greenwood, Suddaby & Hinings 2002). Accepted and commonly shared institutionalized facts, norms, and structures in an organization, existing social arrangements, explicit or implicit political disputes and arguments, technical considerations by various actors all create numerous social, political, and technical forces on a technology in an organization.

Social forces are comprised of local forces which construct the expectations and understanding of the opportunities, constraints, and organizationally defined routes to change (Kelly and Amburgey, 1991, p. 610). Social forces can both promote certain options and devalue others during the process of technology adaptation. By incorporating the local social dynamics of an organization, the RDT model is able to accommodate the existence and impact of multiple organizational narratives and competing histories of change, as part of the social texture of the organization.

Political forces are comprised of the political status of consultation, negotiation, conflict and resistance, which occur at various levels in an organization. They are taken to refer to the political structuring within an organization, such as the power disputes between several individuals or organizational units. Other examples of political forces might be negotiations between trade union representatives and management, between consultants and various organizational groups, and between and within managerial, supervisory and operative personnel. These forces can influence decisions and the setting of agendas at critical moments during the process of technology adaptation.

Technical forces represent state and related dynamics of the existing technology and technical affairs in an organization. Technology adaptation does not take place in a technical vacuum, but it should always be considered in relation not only to the existing social and political arrangements but also the technical requirements of an organization. Therefore, in the process of technology design, implementation and use, social, political, and technical situations continue influencing actions. These influences are represented as a set of social, political, and technical forces originating from the local organizational context in the RDT model.

Proposition 2: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with social, political, and technical organizational forces in the immediate environment.

3.1.2. Dispose Design, Implementation and Use

The arrows (a) in the RDT model signify a structural element disposing an action, which involves internalization and mobilization of paradigms, schemas, and logics to dispose design, implementation, and use.

Paradigms dispose technology design and are mobilized by designers. The macro agency of designers oversees the acquisition of a technology in an organization. Technology designers, top managers, program managers all have macro level agency capacities to create and change design, such as choosing a technology as well as changing the organizational scope or technology of choice. However, this argument should not lead us to technological determinism. Paradigms are by no means entirely unambiguous but susceptible to interpretation in multiple ways by different macro agents; in other words, paradigms have interpretive flexibility (Orlikowski, 1992).

Schemas dispose technology implementation and are mobilized by meso agents during preparation and execution of configuration and implementation plans. Schemas of technology can also be interpreted in different ways by implementers. Designers who at the meso level agency may decide and modify the implementation of technology artifacts, hence dispose technology implementation from schemas. Likewise, logics dispose action of technology use and are mobilized by micro agents. They are shared among agents; however, they can also be interpreted differently by different agents (Orlikowski, 1992).

The degree of the interpretive flexibility of paradigms, schemas, and logics depends not only on the stage of technology adaptation as articulated by Orlikowski (1992) but also on whether the technology is hard or soft. As previously described, the power mechanism in disposing of action is expected to be based on *discipline or domination*, depending on whether its target has the ability to choose or not. For hard technologies, the mechanism is expected to be domination, whereas for soft technologies, expected mechanism is discipline since targets have more ability to interpret the technology differently.

Proposition 3: Paradigms *dispose* the technology *design* by dominating the designers when the subject is a hard technology and disciplining them when the subject is a soft technology.

Proposition 4: Schemas *dispose* the technology *implementation* by dominating the implementers when the subject is a hard technology and disciplining them when the subject is a soft technology.

Proposition 5: Logics *dispose* the technology *use* by dominating users when the subject is a hard technology and disciplining them when the subject is a soft technology.

3.1.3. Contextualization of Schemas and Logics

The arrows (b) in the RDT model stand for the actors' contextualization of structural elements for their organizational context. Contextualization refers to translating the paradigms into schemas via design and reconciling the schemas with logics via implementation. Design is contextualized into schemas by macro agents; whereas implementation is contextualized into logics by meso agents.

Actors at higher levels create both limits and opportunities for actors who are at lower levels (Mouzelis, 1995) during contextualization of paradigms into schemas or schemas into logics. Schemas and logics are created with the contextualization process and have no capacity to resists initially; therefore the related power mechanism is expected to be *force* (Lawrence, Winn and Jennings, 2001). This also leads to an indirect exertion of force by designers on implementers and by implementers on users through the shaping of schemas and logics.

Proposition 6: Designers *contextualize* the *paradigms* into *schemas* with *force*.

Proposition 7: Implementers *contextualize* the *schemas* into *logics* with *force*.

3.1.4. Conflicts between Use, Implementation, and Design

The arrows (c) in the RDT model refer to those actions that conflict with their prior actions. Causally explainable conflicts among groups of actors in the organization may lead to revisions of prior actions. The action of using technology may conflict with its prior action of implementing. Likewise, the action of implementing may conflict with its prior action of designing. Such conflicts may build up organizational pressures for change at the social integration level, i.e. the action realm (Archer 1982; Archer 1995).

Technology decisions taken at macro and meso levels tend to become taken-for-granted premises for users because they have little influence on such decisions. This, however, does not deny the possibility of the lower level agency to act independent of the meso or macro agency. The patterns of practice at the micro or meso levels cannot be completely defined from a higher level. Users have micro level agency and can modify the way they employ the technology. They may stretch the appropriate protocol of using a technology on their own or ignore some functions of a technology, causing some small changes in some technology artifacts, which can accumulate over time. In addition to their chances of challenging the rules and resources (e.g., technical features) of technology in everyday use, they may interact and accumulate their revisions to produce a higher order of change in implementation. Additionally, users can strategically develop a collective agency to compete with implementers and influence implementation. Similarly, modifications in implementation by implementers or due to accumulated conflicts between design and implementation by users can create conflicts and cause changes in design.

In these processes, the expected power mechanism to be exercised is *influence* (Lawrence, Winn and Jennings, 2001) because the source of the power is agency based which is not omnipotent over its target. Conflicts originate from lower level agents and target higher levels.

Proposition 8: When technology use drifts significantly, it conflicts with and exerts influence on technology implementation.

Proposition 9: When technology implementation drifts significantly, it conflicts with and exerts influence on technology design.

3.1.5. Modification of Logics, Schemas and Paradigms

The arrows (d) in the RDT model correspond to modification of the structural elements with habitualized actions. Several agents in an organization may revise their scripts of action and drift from the original actions disposed by their respective structural element. Such changes may create pressures for change at the structural realm, i.e. at the system integration level. Because of the interpretive flexibility of technology (Orlikowski, 1992), such drifts may still be accommodated within the multiple dispositions of the same structural element; and hence structural elements, such as paradigms, schemas or logics, may support the drifted action. However, if drifts move beyond a level and become a shift in action, the structural element may become unable to keep supporting the action. In this case, changes in action either fade away or become objectified requiring modifications in the structural realm.

For example, users of a technology may start using it quite differently from the purposes that were initially projected or may ignore some functionality of the technology. Similarly implementation may be changed by implementers or by accumulated revisions of users. Such drifts may still be accommodated within the dispositions of schemas. However, if drifts are fundamentally beyond the dispositions of logics or schemas, then they may fade away and the use or implementation may drift back to a level that can be justified by the original logics or schemas. Alternatively, if the agents who use technology differently or revise its implementation exercise enough influence, the situation may become objectified and the logics or schemas may change towards a new state that would justify the new use. A similar mechanism is expected to work at design. However, due to the external nature of paradigms, it is expected to happen quite rarely, since influence required to change the external paradigms would be very high.

Since action realm components have limited effect on their structural counterparts, the process from the action realm towards the structural realm can only have an influencing power on its target.

Proposition 10: When drifts in technology use cannot be accommodated within multiple interpretations of logics, technology use modifies logics through influence. If logics cannot be modified, then drifts in use would eventually recede and be abandoned.

Proposition 11: When drifts in technology implementation cannot be accommodated within multiple interpretations of schemas, technology implementation modifies schemas through influence. If schemas cannot be modified, then drifts in implementation would eventually recede and be abandoned.

Proposition 12: When drifts in technology design cannot be accommodated within the multiple interpretations of paradigms, technology design modifies paradigms through influence. If paradigms cannot be modified, then drifts in design would eventually recede and be abandoned.

3.1.6. Structural Contradictions and Reconfiguration

At any point in time, contradictions may arise among the components of the structural realm. In such cases, a structural reconfiguration is expected to get initiated in structural order without the participation of a causal agent. Such structural contradictions may be due to accumulated objectified changes coming from prior actions or diffusion (DiMaggio & Powell, 1983) of a new institution from a wider organizational environment. Structural reconfiguration would then influence the action realm as well.

The processes between structural realm components, namely logics, schemas and paradigms are expected to operate with *domination*. Both sources and targets are structural, and order gets established with domination between conflicting structural elements.

Proposition 13: When logics and schemas contradict, they regulate each other with domination.

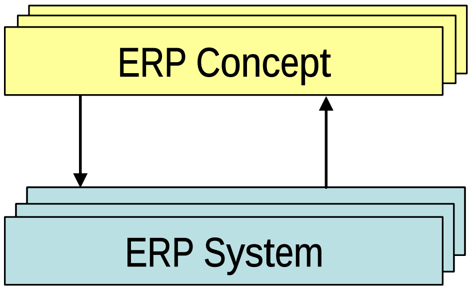
Proposition 14: When schemas and paradigms contradict, they regulate each other with domination.

3.2. Recursive Dualism of Enterprise Resource Planning

Following the RDT model, ERP is comprised of two distinct realms, namely, the structure realm and the action realm. The structure realm corresponds to the ERP concept and is entirely social, covering all elements that virtually governs organizational practices on ERP in the action realm, whereas the action realm corresponds to the ERP system and is therefore artifactual. Both realms of ERP are recursively implicated as proposed by RDT.

Thus, the ERP concept (structure realm) is dependent upon, but due to its own causal capacity (Archer, 1995), has direct consequences for the ERP system (action realm). In this sense, the ERP system is disposed but not predetermined by the ERP concept in time and space (Figure 3.2). The use of the term "ERP system" is beyond usual perception of an ERP system as an ERP software application and covers all artifacts and related practices by organizational participants.

Figure 3-2 Recursive dualism of ERP concept and ERP system



If elements of the ERP system are to be sustained or reinforced over time, the existing or emergent ERP concepts must support them. In the absence of this condition the ERP system and related changes in action are expected to eventually fade away and be abandoned. Similarly, ERP conceptual elements tend to perish if elements of the ERP system do not support them. An ERP system beyond the limits of an ERP concept is possible with the conscious changes and unconscious deviations in action that changes artifacts of ERP technology in a specific organization. The degree of support determines the endurance of the ERP adaptation. A weak and discontinuous support between the concept and the system may lead to institutional decay or deinstitutionalization of the existing order in ERP (Greenwood, et al., 2002; Jepperson 1991; Scott 2001), or passing away of the newly introduced changes in the ERP system or the ERP concept.

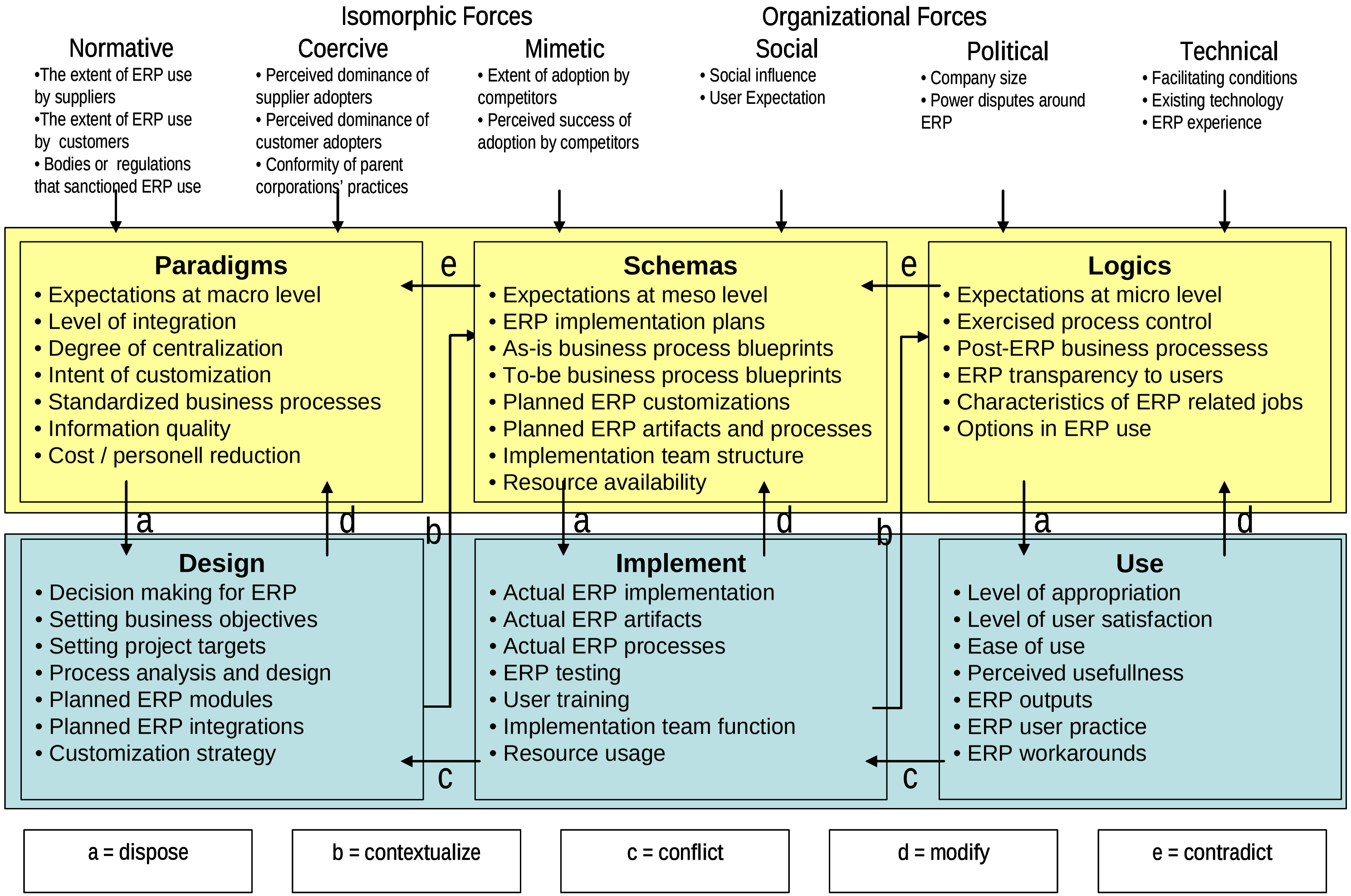


Figure 3-3 Recursive dualism of enterprise resource planning

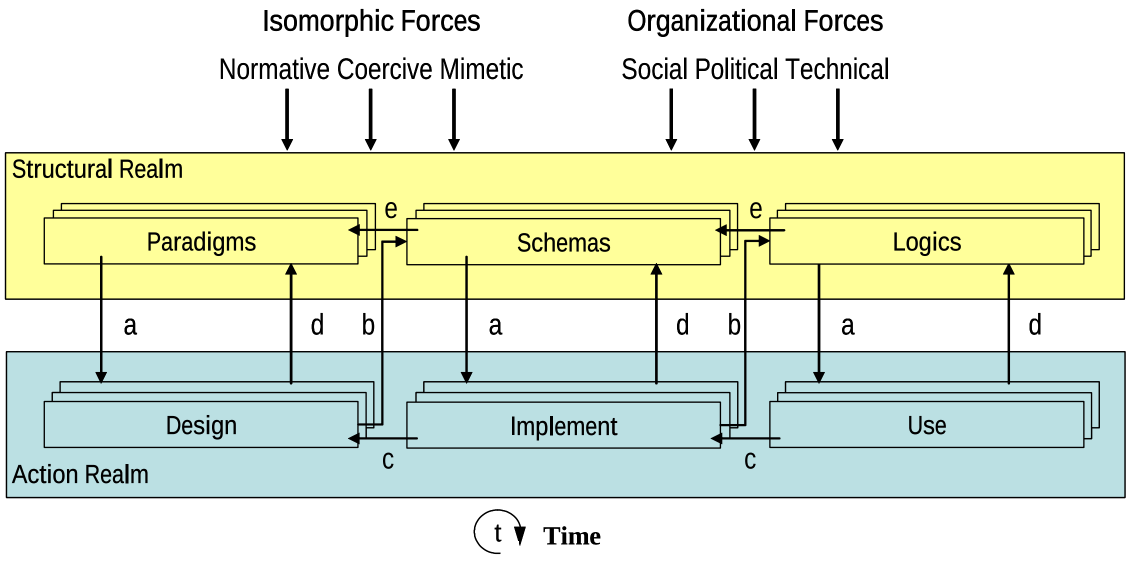
Following the RDT model, I am describing ERP technology in organizations in relation to (i) contextual forces, (ii) an ERP concept (structural realm) that consists of ERP paradigms, ERP schemas and ERP logics, and (iii) an ERP system (action realm) that consists of ERP design, ERP implementation, ERP use and their interaction processes (See Figure 3.3). Based on the RDT model propositions developed in this chapter, research propositions are devised to explain ERP adaptation as a special case of technology adaptation in organizations and presented in Table 3-1.

The RDT model offers a comprehensive understanding of technology adaptation in organizations. Reconstructing duality of technology model (Orlikowski, 1992) considering recent work in social theory (Archer 1995; Mouzelis 1995) and organization studies (Barley and Tolbert, 1997), it provides a way of understanding technology as institutionalized in the social structure and enacted by human agency. Incorporating institutional and structurational views, the RDT model provides the basis for explaining how technology evolves and transforms with the actions and interactions of actors who are also embedded in social structure.

Our study to empirically investigate the RDT model for ERP technology is also an attempt to bridge the gap between the ERP concept and the ERP system research streams. This perspective provides a comprehensive understanding of the ERP concept, that is entirely social, and the ERP system, that is entirely artifactual, which are recursively related. Using the RDT model, I consider both the ERP concept and the ERP system simultaneously but distinctly during the process of ERP adaptation.

Having applied the RDT model propositions to ERP adaptation in this chapter, I present the case research design in the next chapter to describe how I study these propositions in various organizational situations.

Table 3-1 ERP adaptation propositions based on the RDT model



a = dispose **b = contextualize** **c = conflict** **d = modify** **e = contradict**

Structural Context of ERP Adaptation
Proposition 1: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with the normative, coercive, and mimetic forces in the wider environment. **Proposition 2:** Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with social, political, and technical organizational forces in the immediate environment.
Disposition of ERP System
Proposition 3: ERP paradigms dispose ERP design by dominating the designers when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology. **Proposition 4:** ERP schemas dispose ERP implementation by dominating the implementers when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology. **Proposition 5:** ERP logics dispose ERP use by dominating users when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
Contextualization of ERP Concept
Proposition 6: Designers contextualize ERP paradigms into ERP schemas with force. **Proposition 7:** Implementers contextualize ERP schemas into ERP logics with force.
Conflicts in ERP System
Proposition 8: When ERP use drifts significantly, it conflicts with and exerts influence on ERP implementation. **Proposition 9:** When ERP implementation drifts significantly, it conflicts with and exerts influence on the ERP design.

Table 3-2 Adaptation Propositions Based on the RDT model (cont.)

Modification of ERP System and ERP Concept
Proposition 10: When drifts in ERP use cannot be accommodated within multiple interpretations of ERP logics, ERP use modifies ERP logics through influence. If ERP logics cannot be modified, then drifts in ERP use would eventually recede and be abandoned. **Proposition 11:** When drifts in ERP implementation cannot be accommodated within multiple interpretations of ERP schemas, ERP implementation modifies ERP schemas through influence. If ERP schemas cannot be modified, then drifts in ERP implementation would eventually recede and be abandoned. **Proposition 12:** When drifts in ERP design cannot be accommodated within the multiple interpretations of ERP paradigms, ERP design modifies ERP paradigms through influence. If ERP paradigms cannot be modified, then drifts in ERP design would eventually recede and be abandoned.
Structural Contradictions and Reconfiguration in ERP Concept
Proposition 13: When ERP logics and ERP schemas contradict, they regulate each other with domination. **Proposition 14:** When ERP schemas and ERP paradigms contradict, they regulate each other with domination.

4

RESEARCH DESIGN

In this chapter I describe the overall research process and explain how I decided on the case study sites, selected methods for data collection and analysis. In particular, I explain how ERP histories at the case sites are traced to learn about the process of ERP adaptation within its organizational context over time.

There are many research design alternatives available to a researcher, such as experiments, surveys, archival analyses, histories, and case studies. Choosing the right design requires the careful consideration of several criteria which include (a) "the type of research question posed", (b) "the extent of control an investigator has over actual behavioral events", and (c) "the degree of focus on contemporary as opposed to historical events" (Yin, 2002). Case study is a method of empirical inquiry that "studies a contemporary phenomenon within its context where research questions are in the form of "how" and "why" rather than "who" and "where" and the researcher has limited control over the phenomenon" (Yin, 2002). The case study method is considered appropriate for the purposes of this study, since I have limited control over the phenomenon, which is embedded in its context and research questions seek to identify "how" and "why" the adaptation takes place. The study does not require having control over behavioral events but focuses on describing and analyzing both contemporary and historical events during technology adaptation.

A number of difficulties arise in research when measuring and testing social processes such as structuration or institutionalization. First of all, any pure quantitative inquiry of structuration and institutionalization would face significant data unavailability. Structural formations and changes are rarely recorded systematically and such archival data are scarce. To deal with this problem, one can resort to a qualitative study, acknowledging that even the best qualitative approach cannot entirely eliminate the associated difficulties. For instance a sample-selection problem bothers qualitative and quantitative research alike; documentary evidence and retrospective interviews are very likely to over-represent the success stories and to overlook the issues that are missed in records and memories. Nonetheless, qualitative methods, such as case studies offer flexibility that is unavailable in statistical models and quantitative investigations (Yin, 2002).

4.1. Case Study Research

We followed the guidelines offered by Yin (2002) and Eisenhardt (1989) in the design of the case research. Yin (2002) provides the details of designing the case study research, whereas Eisenhardt (1989) describes the process of developing theories from case study research. The case study strategy can be contrasted to the ethnographic approach, which is an alternative strategy for studying "how" and "why" type research questions. Some qualitative researchers follow ethnographic methods and seek to satisfy two conditions: (a) the use of close-up, detailed observation of the natural world by the researcher and (b) the attempt to avoid prior commitment to any theoretical approach. Since I have developed the RDT model theoretically based on previous theory and research, ethnographic approach is not appropriate. However, ethnographic research does not always produce case studies, nor are case studies limited with these two conditions. Instead, case studies can be based on prior theories and can be "supported by quantitative or qualitative evidence". In addition, "case studies need not always require direct, detailed observations as the primary source of evidence" (Yin 2002, p.15). Case study research requires the researcher to deal with many different sources of evidence: documentation, archival records, interviews, direct observations, participant observation, and physical artifacts. It "attempts to thoroughly assess a cluster of factors by focusing on a small number of cases" (Adams and Schvaneveldt, 1985). Yin (2003, p.5) identifies six kinds of case studies based on a 2x3 matrix. In the first axis of differentiation, the study can be based on a single case or multiple cases. In the second axis, the study can be exploratory, descriptive, or explanatory. An exploratory case study aims at defining the questions and hypotheses of a subsequent study. A descriptive case study covers a complete description of a phenomenon within its context. Whereas an explanatory case study reports on data that explains how phenomenon occurred reflecting a causal relationship (Yin, 2003, p.5). Obviously, selecting any of the case study approaches requires different orientations in research design.

4.2. Case Study Issues

Since the focus is to explain why and how technology adaptation unfolds in a specific way, I selected explanatory case study as the preferred research design orientation (Yin, 2002). The RDT model is used to explain how ERP adaptation takes place in organizations. Case studies have often been criticized for not being representative enough, their limitations in reaching general conclusions , and the potential investigator bias. It is clear that case studies cannot "prove" a proposition, with the certainty of "true experiments", which allow researchers to make causal conclusions based on study results. However, since a true experiment approach cannot be used for this research, "an explanatory case study with multiple cases" (Yin 2003, p.69) is considered to be the most appropriate. After further development and empirical analysis of RDT, related constructs can be developed and quantitative techniques such as survey instruments might be employed. The study makes use of several case study tactics and case sampling approaches to improve the validity and reliability of the study and to reach better generalizations.

Since the main focus of the study is to develop an understanding of technology adaptation in organizations, the unit of analysis is an ERP project in an organization. If an organization had two different ERP projects then it is considered as two different cases. Since such a case couple allows us to control some of the variability inherent in the context of the cases, it becomes possible to make more informed between-case comparisons.

4.3. Case Study Design

To establish the quality of any empirical social research, four tests, which are also relevant to case study research, have been commonly addressed: construct validity, internal validity, external validity, and reliability (Yin 1994).

Construct validity refers to establishing correct operational measures for the concepts being studied. This test is especially problematic in case research since subjective judgments are used to collect the data. Internal validity is concerned with causal case studies that determine whether one event (x) leads to another event (y). If the investigator incorrectly concludes that there is a causal relationship between x and y without knowing that some third factor, z, has actually caused y, the research design will fail internal validity.

External validity deals with the problem of knowing whether a study's findings can be generalized beyond the immediate case study. This concern especially arises in a single case research design. In order to improve external validity of this study, I followed a multiple case-study approach in a number of polar organizational conditions to identify whether the theory is capable of explaining such conditions.

Table 4-1 Case study tactics employed in the research design

Tests	Case study tactic	Research Design
Construct validity	**Use multiple sources of evidence**	Multiple interviews with multiple stakeholders from different instances of the adaptation Other modes of interaction—over dinner, e-mail, telephone, etc. Documentary evidence, and participant observation
	Establish chain of evidence	Detailed processual narratives referencing interview transcripts Taping and transcription of interviews immediately
	Have key informants review case study drafts	Some key informants checking drafts of the case study reports
Internal validity	**Do pattern-matching**	Patterns identified across cases Empirical patterns matched with propositions
	Do explanation-building	Some causal links and explanations using RDT
	Do time series analysis	Adaptation chronology from interviews and archival sources
External validity	**Use replication logic in multiple-case studies**	Utilization of the same protocol in each case Each case as a separate study evaluating same set of propositions
	Increasing degrees of freedom	Multiple observations for each proposition Multiple embedded cases
	Use existing theory	Analytical generalizations using existing theory
Reliability	**Use case study protocol**	Utilization of case study and interview protocols in all cases
	Develop case study data base	Case study notes (annotated transcripts) Case documents (documents, brochures, etc.) Case narratives

Reliability makes sure that, if a later investigator follows exactly the same procedures described by an earlier investigator and conducts the case study all over again; s/he will reach at the same findings and conclusions. In preparing case studies, several tactics are used to increase the validity and reliability of the research (See Table 4.1).

We followed a consistent protocol during the preparation of all case studies. The most suitable personnel (typically the ERP project director and if possible their manager in the organization) were identified. These potential informants were contacted via electronic mail, which outlined the research and requested their cooperation. The electronic mail was followed up with a telephone call to further explain the study, get an approval and arrange a meeting to plan the study. In the initial planning meeting, these initial contacts were also asked to provide other potential informants who were involved in the adaptation of ERP from varying levels of the organization. Each site was then visited 6 – 7 times for semi-structured oral interviews, archival data analysis, and participant observation at the sites. The interview protocols were developed to get information regarding to the elements of RDT. Each element of the RDT model was targeted with a set of questions presented in Appendix A. Three interview protocols for macro, meso and micro agents were derived from these questions and are included in Appendix B.

Yin (1994) discusses six sources of evidence: documentation, archival records, interviews, direct observations, participant-observation, and physical artifacts. All these sources have their own strengths and weaknesses. Yin (1994) recommends using different sources for achieving triangulation. Although no single source has a complete advantage over all the others, documentary evidence is considered important for verification and extension of interview evidence (Yin 1994). We used three sources of evidence in preparing the cases—interviews, non-participant observations, and analysis of secondary data (organizational documents and archives) to ensure "that the concepts and patterns identified are grounded in the experiences and terminology of actors" (Glick et al. 1990, p. 302).

Analyzing case study evidence consists of examining, categorizing, tabulating, and rearranging the evidence to address the initial propositions of a study. Two dominant analytic techniques are used in analyzing case study data: pattern matching, and explanation-building(Yin 1994). Developed patterns, explanations, and observations matching to the RDT model propositions are described in case narratives together with time-based chronologies of ERP adaptation in Chapters 5 – 8.

4.3.1. Qualitative Interviews

Semi-structured interviews were performed following the three interview protocols (See Appendix A) for designers, implementers, and users, which lasted approximately 60-90 minutes each. Most interviews were tape-recorded and transcribed verbatim. Some of the meetings with top managers could not be tape-recorded, however, detailed handwritten notes were taken and the sessions were transcribed following the interview. All interviews were planned as one-to-one interviews and they were also supplemented by multi-participant discussions, where possible. Informants were also asked to fill out a project history in the form of a timeline, showing when activities were undertaken, and when unusual events (e.g. resignation of a project manager, an ERP module going live) took place. These descriptions were consolidated and reconciled from archival sources for correctness and completeness to prepare project chronology.

In an effort to address different levels of actors and structures in the RDT model and the potential limitations of retrospective interviews, multiple informants from different hierarchical levels and with varying responsibilities ranging across operations, finance, human resources, and information technology were interviewed. External consultants who took part in ERP adaptation were also interviewed where available.

The selection of the individuals who were active during the ERP design, implementation, and use for interviews was carried out through systematic, snowball sampling, "where one informant gives the researcher the name of another informant, who in turn provides the name of a third and so on" (Vogt, 1999). Since the goal of these interviews was to collect the complex threads of social experience, considerations of variety rather than representativeness governed the sampling. The objective was to collect a full range of possible accounts, not to measure the frequency of ERP adaptation accounts of organizational participants. Thus, the research design attempted to locate informants with distinctive social locations in relation to design, implementation and use of the ERP technology in the organization. In order to minimize the possibility of encountering idiosyncratic sub-groups, samples were generated with multiple snowballs, each originating separately from different individuals in the organization.

In addition to collecting information on pre-specified topics these semi-structured, open-ended-question interviews represent a valuable check on the RDT model, providing empirical feedback with a minimum of paradigmatic presuppositions. In combination with the other methods employed, this qualitative analysis permits a substantial amount of "empirical triangulation" (Jick 1979), enhancing both the depth and the multi-method validity of the resulting conclusions.

In order to assure external validity and reliability, preliminary interview protocols were prepared with a wording that reflects the on-going nature of design, implementation, and use. Interview questions were developed to question the RDT model concepts at different moments of adaptation and constructed with a perspective that acknowledges differences in time. Interview protocols are included in Appendix A.

Both the structuration view of change (which requires identifying a sequence of critical events in action) and the institutionalization view (looking for changes in the social structure) were taken as starting points. The protocols were used to ensure a repeatable base of common discussion across interviews, but all participants were encouraged to talk about the issues that were important to them so that new dimensions could emerge.

As the interviews were completed, they were transcribed and analyzed. Interview analysis consisted of reviewing the transcriptions of the interviews to identify critical episodes and interactions as well as areas where changes and processes described in the model are observable. Common themes were identified, and then the interview transcripts were re-examined to further develop the themes and explanations. Interviews and observations at different organizations were used in comparison to further elaborate on the RDT model. The intention was to "uncover the underlying generative mechanisms that cause events to happen and the particular circumstances or contingencies that exist when these mechanisms operate" (Van de Ven and Huber, 1995, p. vii), and see whether they follow the RDT model thus to empirically evaluate the RDT model considering the empirical evidence (Van de Ven, 1987).

4.3.2. Non-participant, systematic observations

Non-participant observation was chosen as one of the sources of evidence that makes it possible to describe what might have happened during agency interactions: who or what was involved, when and where the decisions were made, how they were made, and why the decisions were as they were. The methodology for non-participant observation is ideal for studying intra- and inter-organizational interactions, because it "is exceptional for studying processes, relationships among people and events, the organization of people and events, continuities over time, and patterns, as well as the immediate socio-cultural contexts in which human existence enfolds" (Jorgensen, 1989, p. 12).

Schwartzman describes an overview of what is looked for and analyzed in these observations as: participants, channels of communication and interaction codes, spatial and time arrangements, frame, meeting talks, norms of interpretation, goals and outcomes (Schwartzman, 1993, p. 63-66), which correspond to the following issues in the research:

Participants – Their relationships, roles and responsibilities in terms of ERP adaptation. How do the relations set up and what roles did the participants seem to assume for themselves and others in ERP adaptation?

Channels of communication and interactive codes – How do the participants communicate before, during, and after their encounters about ERP?

Spatial and time arrangements – How much time and space were allocated to the ERP adaptation activities.

Frame – What marks the beginning, middle, and end of the observed events in ERP adaptation as well as their duration?

Meeting talks – Observation of the topic and the results, use of technology, communication genres and styles employed, interest and participation, decision-making strategies, degree of formality and degree of preparedness in ERP-related meetings.

Norms of Interpretation – The development and maintenance of a central focus of ERP related discussions.

Goals and Outcomes – Distinction between the ERP related goals of each individual and the outcomes pertaining to the organization to reveal conflicts and contradictions surrounding ERP adaptation.

Considering these issues imposed a structure and formalism to observations at different instances in multiple cases. Non-participant observations were not used to establish any causal link however it helped us to make sense of the web of social relations and relate the evidence collected from various sources at case sites.

4.3.3. Organizational Documents

Along with the interviews, the examination of archival sources provides multiple perspectives and helps us reconstruct informants' initial expectations and their activities and experiences over time, retrospectively. The main aim of this step is to collect information regarding to the past ERP implementation experience of the organizations, to collect information regarding to state and changes in the ERP concept and system using organizational and public literature. It includes a thorough analysis of key records and documents regarding to ERP focusing on:

- Organizational records, such as organizational charts and ERP project budgets, results of any prior surveys, ERP project meeting agendas, minutes, and system change requests.
- Personal records, such as electronic mail, paper correspondence, memos, and notes from meetings related with ERP design, implementation and use.
- Publications and internal written communications that were commonly referred in the organization. This includes journal articles, brochures, and annual reports especially when they include ERP related issues.
- Computer-based research study of many of the actual electronic records and sites, such as the current and old web sites of ERP vendors, the online ERP system and subsystems.

During data analysis a three-step procedure was followed. First I searched for temporal patterns in adaptation. Second, I examined the identified patterns for evidence of conflicts and contradictions and whether they had been resolved or not. I was particularly interested in instances where a conflict or contradiction related to ERP came into existence. Third, having identified patterns, I searched for evidence of underlying forces that would explain their occurrence at the case site. This method also follows Eisenhardt's (1989) suggestion that observed relationship be validated by seeking reasons from them in the local context.

4.3.4. Selection of Case Sites

Any case study can be performed with single or multiple cases. Although it is partly possible to make some generalizations from single cases in some analytic way, multiple-case studies strengthen or broaden such generalizations like similar situations in multiple experiments. Yin (2002) distinguishes between literal replication where the cases are designed to back each other and theoretical replication where the cases are designed to cover polar theoretical conditions. In order to evaluate the theory empirically on varying conditions, I selected the latter approach where one might expect different results but for predictable reasons. I aimed to observe the RDT model in diverse settings and polar organizational situations. In total I planned five cases in four organizations with implementations of four different ERP systems involving different designer / implementer / user groups. The cases were selected on the basis of contextual and prior information from public sources. Due to the confidentiality reasons of the participating companies, I could not use the actual names of the companies, their consultant companies, and ERP software vendors in the dissertation. Therefore, pseudonyms in capital letters are used in order to keep each company name anonymous (See Table 4-2).

Table 4-2 Case study sites

Company	Industry	ERP Technology	Time	Number of Interviews
ALPHA	Service	MERCURY	1Q2004	10
ALPHA	Service	MINERVA	1Q2004	10
BETA	Manufacturing	PHAROS	4Q2004	9
KAPPA	Chemicals	MERCURY	2Q2004	12
ZETA	Automotive	NEPTUNE	3Q2004	12

For each company, I started the interviews with three key informants from different levels of agency (macro, meso and micro agents for ERP decisions) and generated a snowball sample until many diverse views were collected and the interviews significantly converged in terms of their content. Since the objective of the field study was to capture insights from various perspectives, informants were selected from people who have taken different roles during ERP adaptation ranging across operations, finance, human resources, and information technology departments.

5

SIMULTANEOUS ADAPTATION OF TWO ERP TECHNOLOGIES IN ALPHA CORPORATION

In this chapter, I describe the simultaneous adaptation of two ERP software applications in the ALPHA Corporation(ALPHA) and explain how ALPHA has undergone an adaptation while establishing its ERP infrastructure. First, I describe ALPHA and its ERP adaptation history. Then, I discuss immediate and wider institutional context and the process of adaptation. I conclude with a theoretical discussion of the ERP adaptation in ALPHA.

5.1. ALPHA Corporation and ERP Technology

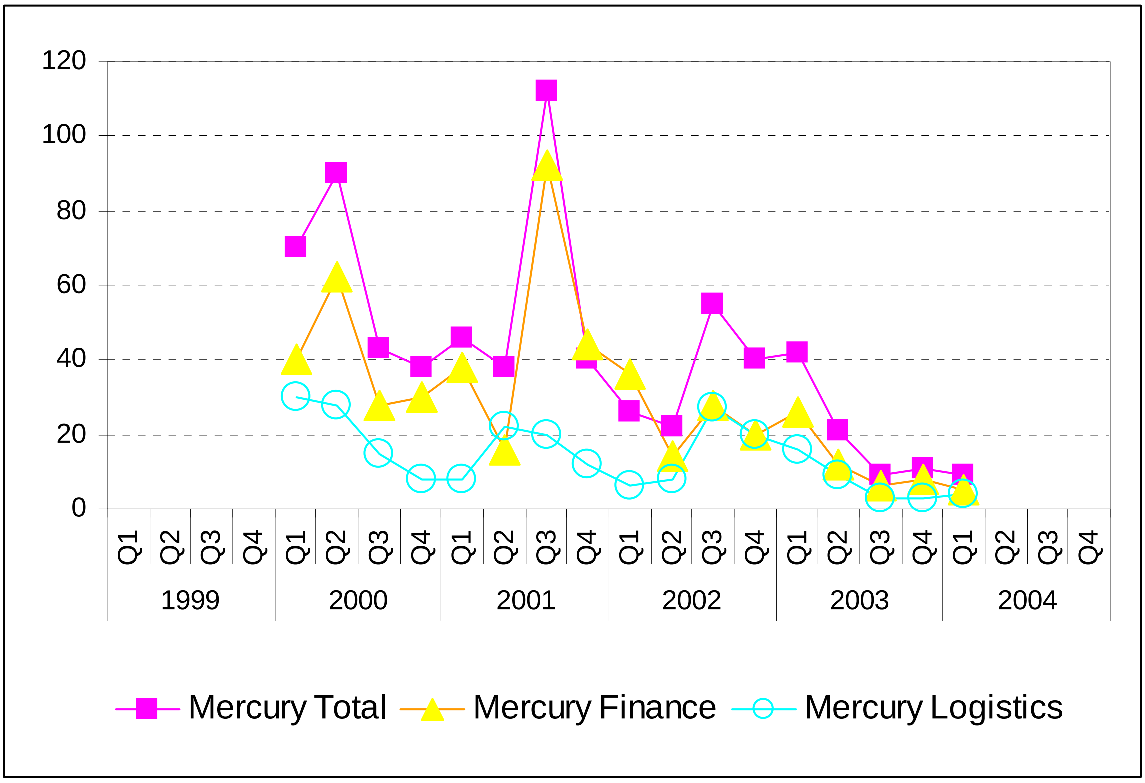
ALPHA is a service company, founded in 1993 and headquartered in İstanbul, Turkey and employed nearly 2,300 personnel as of January 2004. It is the industry leader in Turkey and it is among the top tier firms in Europe. I selected ALPHA for a case study in ERP adaptation because with concurrent adaptations of two ERP systems for different functionalities in the same organization, it represents a polar situation, which is empirically richer to observe the explanatory nature of the RDT model. Due to the non-disclosure agreements with ALPHA, further details of the industry and the demographics of the company cannot be disclosed in the study. The ERP Adaptation chronology and a summary of the RDT model based dynamics of ALPHA are included in Appendix C.

ALPHA management decided to consider having an ERP software application in the beginning of 1997. Following the general practice followed by large companies, ALPHA decided to choose its ERP solution with the guidance of a big management consulting company. Proposals were collected from two major management consultant companies, APOLLO Consulting and ATHENA Consulting. In the middle of 1997, ALPHA selected APOLLO as its consultant for ERP selection and design. However, the selection process could not start until 1998, since, according to the IT manager, the company had "*higher priority items in its agenda*" (ALPHA Designer Interviews, 2004).

In the first quarter of 1998, APOLLO started the ERP selection project and asked for their ERP priorities from the top managers and functional ERP requirements from the users. APOLLO performed a series of workshops and process analysis studies to describe the existing situation of the related business processes, where available. APOLLO could not make an as-is process mapping of the whole ERP scope, because ALPHA was planning to acquire ERP to support some business processes, which were non-existent at that time. In the middle of 1998, ALPHA issued a Request for Proposal (RFP) to three different international ERP vendors. As part of the RFP evaluation process, ALPHA design team made site visits to vendor-supplied reference sites in Turkey and other European countries. At the end, APOLLO suggested NEPTUNE ERP to ALPHA. However, some of the managers did not agree with this suggestion claiming that it was not strongly justified and was subject to some questionable assumptions on the functional requirements of ALPHA. Meantime, ALPHA's largest competitor decided on NEPTUNE as its ERP system. ALPHA wanted a second opinion on ERP selection and asked a local consulting company called POSEIDON for a re-evaluation of APOLLO's work. At the end of this "counter-consulting", POSEIDON recommended that ALPHA should go with MERCURY's proposal. In MERCURY's proposal, two different ERP applications were planned to work as an integrated ERP system. MERCURY offered its solution in conjunction with MINERVA, a different ERP application, since MERCURY's functionality did not cover asset and maintenance management functionality. Therefore, MINERVA had to be implemented as an integral module of MERCURY in ALPHA.

Both MERCURY and MINERVA implementation projects started by the end of 1998 and continued into 1999. In 1999, a software company was contracted by ALPHA to make significant revisions and customizations on MINERVA according to ALPHA's specifications. After that, MERCURY implementation had continued like a typical off-the-shelf software implementation, without any major modifications but MINERVA had undergone a major change in terms of both its internal structure and outside integrations with other systems. In the last quarter of 1999, MINERVA, and following that in January 1, 2000, MERCURY implementation covering finance and accounting became live. Following that, after users familiarized themselves with the system, they started to demand some technical modifications both in MINERVA and MERCURY, increasing the number of technical change requests for both systems as shown in Figure 5-1 and 5-2 respectively for MERCURY and MINERVA. These change requests originating from users and the target of the request (meso actors) has an option to act otherwise, exemplifying an influence-type situation.

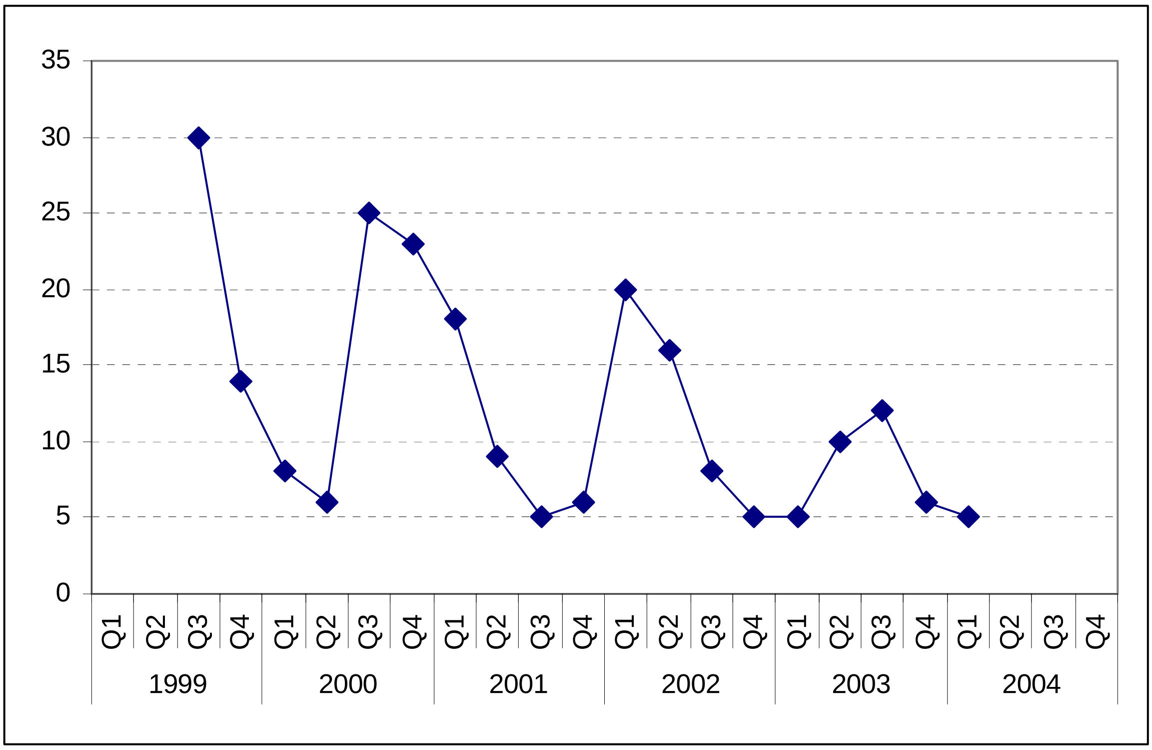
Figure 5-1 Number of change requests for MERCURY



At the beginning of 2000, ALPHA's accounting auditor ARAMIS visited ALPHA, to perform the accounting audit of the previous year and also to check the financial accuracy of the new ERP system. In this audit, ARAMIS required several additional accounting controls in the MERCURY implementation and demanded some changes in MERCURY Finance module, increasing the number of change requests for MERCURY Finance in the first quarter of 2000.

In order to keep up with the timing requirements of additional financial controls, ALPHA contracted another software company to change the MERCURY implementation and to prepare the required financial controls. In the meantime, the implementation team of MINERVA had been working on the modifications asked by the users and decreasing the total number of open technical change requests for MINERVA.

Figure 5-2 Number of change requests for MINERVA



In the middle of 2000, organizational units covering the majority of MINERVA users had been given the authority to make modifications on MINERVA as they needed. ALPHA had also contracted BOSPHORO company for more complicated modifications. After this agreement, the contractor started collecting technical change requests annually and routinely made the requested changes, as shown in Figure 5-2. Meantime ALPHA has become listed in the stock exchange and user dissatisfaction with MERCURY peaked during 2000. In the second half of 2000, ERP project manager had to leave ALPHA when user's collectively resisted against him and influenced their managers to act against him, while the number of change requests was also increasing for the MERCURY Finance (See Figure 5-1).

At the beginning of 2001, a new project manager was recruited and assigned to continue with the rest of the MERCURY implementation and to perform a major version upgrade for MERCURY. The implementation team performed extensive tests in the first half of 2001 on this version upgrade. However, following the testing period, the new project manager decided to upgrade MERCURY to an untested higher version. Due to this untested upgrade, the ERP system crashed and could not resume its normal operations for nearly 3 days. During this crash, sensitive financial data was lost creating major problems in accounting. After that crisis, the second project manager was asked to resign and the number of change requests reached the highest point in its history for MERCURY Finance.

After the crisis due to MERCURY upgrade passed, a third project manager was assigned to implement purchase order, fixed assets, and inventory modules of MERCURY Logistics. This was started and finished within the year 2002, without many problems. In 2003, MERCURY implementation reached stability and further implementations and version upgrades were postponed to an unforeseen future, together with MINERVA, which had been facing upgrade problems due to extensive customization. In the middle of 2004 APOLLO Consulting returned to ALPHA for ERP post-implementation assessment and they suggested implementation of some of the modules that were purchased but not implemented. However, their suggestions had not been followed until the middle of 2005.

After years of adaptation, the scope and nature of MINERVA has been significantly changed and its footprint in ALPHA over-expanded with a large increase in the functionality covered by the original and custom built modules. On the other hand the scope of MERCURY has significantly narrowed, where some of the modules are purchased but not implemented. In all stages of ERP adaptation, significant signs of instability and resistance appeared for MERCURY in the form of the high number of change requests (see Figure 5-1), whereas MINERVA adaptation had been rather unproblematic, showing a regular pattern in terms of the number of change requests (see Figure 5-2). Similar to MINERVA, the logistics module of MERCURY had shown a rather regular pattern for adaptation, whereas the MERCURY Finance module seems to be the center of debate. Most of the problematic issues mentioned during the interviews were about the MERCURY Finance module.

5.1.1. The Wider Context

Before ERP, ALPHA had been using a typical financial accounting software application, which is "most appropriate for a medium sized company" and "would not be enough for ALPHA" (Alpha ERP Designer Interviews, 2004). Equipment vendors and maintenance service providers were also complaining about the complexity and speed of asset and maintenance management processes in ALPHA. With similar comments and expectations, some stakeholders had clearly been expecting ALPHA to carry out its operations using an ERP system, supporting ALPHA to implement some of the ERP software.

Most of the large-scale companies were announcing their ERP decisions and implementing ERP was an industrial norm. Since it is one of the largest among those companies, both the software industry and the competitors were expecting the announcement of ALPHA's ERP decision. As one manager described:

> It seemed that only we were left. All large accounts, even some dealer networks had already decided on or had even been using some ERP systems. We were supposed to be the leader in technology, however our competitor was about to implement ERP. We couldn't have lagged behind; there was a strong expectation in the industry. (ALPHA Designer Interviews, 2004)

Additionally, ALPHA had been operating in a recently regulated industry. The regulatory authority had been asking for precise reports regarding to ALPHA's business parameters and performance metrics. ALPHA was obliged to provide detailed and precise data to the authority; otherwise, it would face significant fines due to noncompliance in reporting. In addition to the coercion of regulatory reporting, ALPHA was planning to be listed in the stock exchange markets, which would extensively increase the complexity and necessity for precision in financial reporting and control. However, without employing some ERP technology, generating reports that were in compliance with regulatory authority and stock market regulations could have been very problematic, if not impossible. Not surprisingly, ALPHA later faced with such allegations from both the investors and the regulatory authority before the completion of its ERP implementation and paid significant fines to the government and investors. This extensively motivated the top managers to finalize the ERP project.

By that time, almost all of the worldwide players in the industry were in the process of purchasing ERP software and announcing their decisions. A large shareholder of ALPHA also announced its ERP decision and started deployment in Europe. Some common operations between ALPHA and their large shareholder might have required integration of some operations, increasing the normative expectation on ALPHA to start its ERP project.

Such expectations have supported ERP in ALPHA not only at the beginning of the purchasing decision, but also throughout the adaptation process. For instance, lately in 2005, the large shareholder company had a potential to increase its market share and asked to integrate its ERP system with ALPHA for financial and operational reporting and consolidation. This inquiry triggered a postponed implementation phase of MERCURY that covers version upgrading and implementation of modules that had been purchased but not implemented previously.

In addition to those normative and coercive expectations, ALPHA also took other companies in its industry in Europe as role models, including its large European shareholder. The ALPHA ERP project teams made a number of site visits to "learn from" other companies in the same industry, in Europe. They also frequently referred to their observations and lessons learned in their discussions of "how ERP can work in a company in the same industry, such as …" in the meeting minutes for the ERP design, implementation, and follow-up in use. An interesting anecdote of this "mimetic" behavior can be observed materially in ERP project newsletters, which highly resembles to another ERP project newsletter collected in a site visit.

Table 5-1 Observations on the wider context of ERP adaptation in ALPHA

Proposition 1: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with the normative, coercive, and mimetic forces in the wider environment.	
Normative	• Having an ERP system was the industry norm. • Stakeholders had been expecting an ERP system. Later, some of them integrated their systems for data exchange.
Coercive	• Legal and regulatory requirements of precise and timely reporting of financial results and operational metrics • Later, with significant fines due to reporting problems supported ERP implementation to overcome some barriers. • A large shareholder wanted to integrate its ERP system. When the shareholder had an option to increase its shares, related phase of ERP project had restarted.
Mimetic	• Site visits to European companies in the same industry and taking them as role models during the adaptation. • Largest competitor's ERP announcement increased the speed of decision making in ALPHA. However, in order to differentiate itself ALPHA switched to the alternative ERP vendor.

As mentioned before, while ALPHA was in the extended period of ERP vendor evaluation, its largest competitor announced its decision to acquire ERP and their preferred vendor, forcing ALPHA to speed up to make its own decision. ALPHA was also about to select NEPTUNE as its ERP system at that time, as observed from the project documentation. However, after the competitor's announcement, ALPHA switched to MERCURY from NEPTUNE. As one manager described in his interview this was to "differentiate itself from the competitor as the market leader". Although, this may seem contrary to the mimetic expectation, competitor announcement actually motivated ALPHA to finalize its decision. The announcement of the competitor made ALPHA change its vendor decision, not the decision for ERP acquisition. According to these observations, ERP adaptation in ALPHA have been positively related with the support of normative, coercive and mimetic forces in the wider institutional context on having an ERP technology (See Table 5-1).

5.1.2. The Immediate Context

ALPHA had the great majority of the market share and was a dominant power in the market. It faced limited competition despite the frequent marketing campaigns of its competitors to attack its customer base. Since the company was recently established, it did not have many legacy applications that would substitute for ERP functionality. A few applications were running for vital functions such as accounting and shipment. Managerial decisions were usually made with limited support of viable data.

In its early years, the focus of ALPHA was to reach the whole national market with its local dealers and centers as soon as possible which required making fast and heavy investments in technology infrastructure. Being in an investment race to cope with the booming demand, competitor moves, and to stay as the dominant player, efficiency was not a major concern for ALPHA. Consequently, the company faced many problems in tracking, controlling, and coordinating its technical infrastructure and equipment inventory. For example, prior to the ERP project, major equipment vendors had been complaining about the complexity and manual nature of the asset management and maintenance and ALPHA outsourced its technical equipment inventory, without any form of control to one of its largest vendors. The vendor who was providing most of the technical assets and equipment started controlling ALPHA's warehouse operations, without ALPHA's exact knowledge on what really was in the warehouse and what was shipped to the field. Therefore ALPHA had to manage complex financial control processes and do manual checks on asset lists and financial accounts to track the material flows precisely. This was a strong technical factor that motivated ALPHA to adapt some ERP technology for financial accounting and equipment logistics.

Table 5-2 Observations on the immediate context of ERP adaptation in ALPHA

Proposition 2: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with social, political, and technical organizational forces in the immediate environment.	
Social	• Existing applications did not meet the user expectations. • Strong expectation among people that the "status-quo" had to change. • ERP had not been considered in relation to savings in headcount hence no employee anxiety had developed about job security.
Political	• Two strong groups within ALPHA (Finance and IT) demanded ERP for various reasons. • Finance manager wanted to control spending and operations in the IT department but the IT manager did not want to be controlled by Finance.
Technical	• Previous problems in tracking, controlling, and coordinating its technical infrastructure, equipment inventory and related financial accounts. • Later, ALPHA switched to MERCURY on January 1^{st}, 2000 to survive against the Y2K software digit problem.

By implementing ERP, managers of ALPHA aimed to become capable of controlling all technical equipment in the warehouse and in the field. In addition to that, ALPHA was not sure about the Y2K (software digit problem) compliance of the old applications that were to be replaced by MERCURY and MINERVA. Therefore, technically ALPHA was in need of an ERP system, preferably on January 1, 2000 at the latest.

At the beginning of the ERP project, the company's administrative processes had already been in place for some years. However, ALPHA was divided into powerful groups reporting to two different vice presidents (VPs). These were the Information Technology (IT) group and the rest of the company which included Finance. The IT group was making large-scale investments and also enjoying significant power within the company. The Finance group was actively asking for a better control of the technical spending of the IT group. Therefore, ERP initiative in ALPHA started from two different sources. First, the IT group wanted an asset tracking and management functionality to be able to control its warehouses and infrastructure investments in the field. Second, the Finance group wanted better controlling and reporting of financial data, especially for the IT group. Therefore both IT and non-IT sides of the organization supported the ERP project on their own terms. The divided nature of the ERP schemas and ERP logics also continued at later stages of the project leading to a two-sided and poorly integrated ERP system and further dominated ERP paradigm in the organization.

At the initial stages neither the organizational units, nor the individuals had resisted to adapt to the ERP technology. The existing systems did not meet the requirements and expectations of ALPHA users. Hence many people expected that the situation could not continue as it had been. By that time, ERP had not been considered in relation to "headcount" savings; therefore employees did not link it to issues regarding to job security. Therefore, the social condition in ALPHA supported having an ERP system (See Table 5-2).

5.1.3. The Macro Level

Interviews and meeting minutes and presentations taken from ALPHA's archives reveal that the ERP paradigm of the macro actors, who selected the ERP vendor and prepared the high-level design for ALPHA, significantly resembles the general ERP discourse in the IT industry, at the beginning of the adaptation. At the macro level, ERP technology was considered as a large-scale, central software application with a number of tightly integrated modules and a database as the central repository of applications and data for the whole company. ERP technology was considered as "*the medium of operational and financial best practices*" (ALPHA Designer Interviews, 2004). The briefing sessions with top-managers in ALPHA emphasized that these best practices had been "*distilled by ERP vendors over different companies and industries*" (ALPHA Designer Interviews, 2004) and ALPHA should not try to change the structure of the ERP system.

ERP design in ALPHA was developed by a senior project team composed of the ERP project sponsor, who was a top manager in ALPHA, other top managers, and ERP consultants, who participated in ERP vendor selection according to the functional requirements of ALPHA. After the design stage, following the ERP paradigm, designers initially planned almost no customization on MERCURY and limited customization on MINERVA. MERCURY and MINERVA were supposed to establish a tightly integrated ERP system to provide "timely and accurate" data for decision-making and financial reporting and to standardize substandard business processes. Despite the gradual implementation strategy, since ERP was aimed to be a comprehensive business backbone to cover the whole company, all modules of MERCURY and two modules of MINERVA were (Asset Management and Maintenance Management) included in the design and later purchased by ALPHA.

One of the main technical purposes of ERP in ALPHA was to control the fixed assets in inventory and at the sites. In order to be able to provide precise financial reports, bill of materials (BOMs) were prepared in great detail. Every single nut-and-bolt at every location in the country had to be tracked and maintained by MINERVA. Since MINERVA was a comprehensive asset and maintenance management module of the MERCURY ERP system, all planned integrations were tight, which required online creation and exchange of data between applications.

MERCURY and MINERVA are two different software technologies and they present different levels of difficulty against change. MERCURY is a configurable ERP technology, where by choosing several parameters in the software, the nature and flow of the business processes within the software can be controlled. However, changing the business process itself extensively and making it fundamentally different from what is available in the software is not possible or “not recommended” by the vendor. Whereas, the situation is different for MINERVA, which is more like a set of functions, procedures, and sub-modules organized in a series of libraries where the designers and implementers can develop their own versions of business processes within the software. It can be considered as a development framework where the designers and implementers have the option to act different from what the ERP software requires. MINERVA imposes some requirements but actors can mostly construct their own processes. In addition to that, finance and accounting, which are to be followed by MERCURY, are more rule-based and defined by laws and regulations, making MERCURY a harder domain technology compared to MINERVA.

The difference between the properties and the nature of the two ERP applications and ALPHA’s experience with them supports the related proposition for ERP adaptation for ALPHA (See Table 5-3). While developing the design of MERCURY, ERP paradigm dominated the designers since they had no option to design differently from what MERCURY required. The preparation of the process blueprints, accounting and inventory identification conventions were strictly dictated by MERCURY. Whereas, MINERVA designers were relatively free to act as they wished, but were disciplined with the general nature and limits of MINERVA, since it allowed extensive customizations and changes in the software.

Table 5-3 Macro Level Observations in ALPHA

Proposition 3: ERP paradigms dispose ERP design by dominating the designers when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• Designers considered ERP as an application repository and the two ERP applications were designed to operate in tight integration. • Designers considered ERP as a business backbone covering the whole company. All MERCURY modules were purchased, although there were no plans of implementing all of them. • Designers considered MINERVA as a data repository. • Asset BOMs and locations defined with great detail in MINERVA. • Almost no modification was planned for MERCURY in design. Minimal modification was planned for MINERVA.

5.1.4. Structuration of the Meso Level

After ERP design was complete ALPHA formed two implementation teams one for MERCURY and the other for MINERVA. Teams composed of experts from finance, accounting, and information technology for MERCURY and logistics, field engineering and IT for MINERVA. The meeting notes of both ERP implementation teams reveal that many details of "*how the business should be carried out according to ERP best practices*" had been widely discussed in ALPHA during the implementation. However, none of the initial design assumptions were modified by the implementation team.

In the beginning of implementation, the implementation team was handed the MERCURY and MINERVA design schemas, which reflect the fundamental assumptions and expectations on ERP implementation. Implementation team could not question those schemas for implementation initially and accepted them. Ideas of changing the design schemas were mostly rejected by the implementation team leaders. Only a few of them were taken to the ERP Steering Committee meetings, all of which had been rejected by the top management.

For example, a group of implementation team members proposed to change the phasing of implementation for the MERCURY modules, which were all purchased. However, the ERP Steering Committee, led by the IT director rejected the proposal. The ERP Steering Committee insisted that time was critical for the project and that the implementation should start immediately. This message further forced the implementation team members to not question the fundamentals, and quickly proceed with the implementation work. As one of the engineers described:

> It was claimed that the available design was the best practice. When we told the consultants that there were other ways of managing processes using MERCURY or MINERVA, discussions just got longer and longer. After long hours, even days or weeks of discussions, we either had to agree or were forced to come to an agreement. The initial ERP framework determined the rules, we didn't have any option" (ALPHA Implementer Interviews, 2004)

Although, the implementation team had made some changes on ERP schemas in later stages of adaptation, in the beginning the ERP schemas underlying how implementation should be carried out in ALPHA had created the boundaries for implementation, supporting the related proposition for ERP adaptation in ALPHA (See Table 5-4).

Table 5-4 Macro–to–Meso level observations in ALPHA

Proposition 6: Designers contextualize ERP paradigms into ERP schemas with force.
• The ERP Steering Committee and the implementation team leaders rejected change requests in implementation. • ERP Steering Committee ordered the implementation team to immediately start implementation, without any modifications in implementation plans and designs.

5.1.5. The Meso Level

As previously described, MERCURY is a harder technology compared to MINERVA. The consequences of this difference are also observable at the implementation stage of the ERP adaptation in ALPHA. The nature of the interpretation of the ERP schemas and the implementation had been different for MERCURY and MINERVA from the beginning. For MERCURY, consultants and engineers tried to configure the ERP system by discussing its parameters. All the existing numbering schemes, process flows, and business rules in MERCURY were implemented in the MERCURY modules. In cases where these business rules were clearly inappropriate for ALPHA, they were implemented with minimal changes and turnarounds devised to make the software act differently without making changes in the software itself (e.g. creating a fake inventory to record missing parts).

However, for MINERVA, from the very first day of implementation, a software development company was contracted to customize MINERVA according to the requirements described by the implementation team. At the implementation stage, the contractor company constructed new business processes for MINERVA as the implementation team wanted. MINERVA functioned as a framework for implementation; however developments and extensions were coded by the contractor. As these clearly indicate, structures imposed by the ERP schemas of MINERVA have disciplined; whereas, the MERCURY ERP schemas have dominated the implementation. These observations support the related proposition for ERP Adaptation in ALPHA (See Table 5-5).

Table 5-5 Meso level observations in ALPHA

Proposition 4: ERP schemas dispose ERP implementation by dominating the implementers when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• ERP Schemas were implemented with minimal changes and turnarounds devised to make the software act differently without making changes in the software itself. • A software development company was hired for customization according to requirements described by the implementation team using MINERVA as a framework

5.1.6. Structuration of the Micro Level

MINERVA became operational in the last quarter of 1999, whereas MERCURY, started operation in the beginning of 2000. Towards the end of the implementation stage, extensive trainings were given to users to describe how MERCURY and MINERVA would be used in ALPHA. The users had been instructed on what ERP was and how it should be used. The daily practices of users were determined and printed in user manuals and taught in training sessions. These were actually proposed logics for the daily practices of users. Both the MERCURY and the MINERVA trainings included recommended ways for understanding how MERCURY and MINERVA should be used and screen-by-screen tutorials for using both systems in daily practice. Preparing the user training materials, exercises, and scenarios of ERP in use, both implementation teams actually created and offered the logics of using ERP for the ERP users.

Primary users of MINERVA were responsible for defining and updating asset information, tracking of assets, “trouble ticketing” and following the service levels for MINERVA. Since there were no related prior business process or software applications for these functions, the logic presented in the training sessions and peer-to-peer workshops were all new. Due to limited knowledge and experience of the MINERVA users, they did not have an option to act different from what was instructed in the training sessions.

However, the situation was different for MERCURY. Potential users of MERCURY, such as the finance and accounting users were previously using Logo, a local software application for accounting and basic finance functionality. Compared to MERCURY, using Logo was much simpler, enabling the users to handle information in fewer “screens” and to perform user tasks more quickly. Therefore users initially resisted using MERCURY. In the beginning, the implementation team attempted to make users believe that MERCURY was superior to Logo. However, since some of the users did not stop complaining, the implementation team leader reported the situation to the immediate managers and the HR department of ALPHA. The “acclaimed leader of the resistance” was assigned to a different location. This move forced all the resisting users to accept the new system, forcefully. In addition to this move, implementation team decided not to run the old and new accounting systems in parallel. Instead, the old system was terminated and replaced by the new system to force the users to perform their jobs on MERCURY, supporting the related proposition, together with the above observations (See Table 5-6).

Table 5-6 Meso-to-Micro level observations in ALPHA

Proposition 7: Implementers contextualize ERP schemas into ERP logics with force.
• The users had been instructed on what MERCURY and MINERVA were and how they should be used. • Resisting users were forced to use and the person who resisted the system most was relocated to a different position. • MERCURY change took place on the New Year day without a concurrent-run, to force the users to use the system as described. • MINERVA users did not have an option to act otherwise because this was their first system and they were not experienced.

5.1.7. The Micro Level

After ERP system became operational, training sessions continued for MERCURY and MINERVA users "to minimize the problems" and "to make people clearly understand what the software was for", as described by the MERCURY implementation team member, who was in charge of user trainings. ALPHA followed a more structured training program with formal training sessions and special training materials for MERCURY, whereas, for MINERVA an informal training approach was taken based on peer influence. "Power users" who were involved in implementation directly trained their peers in their unit performing short formal sessions and longer informal workshops.

Although the initial user tendency of not using MERCURY was overcome, the user's resistance did not completely go away. Since the users were expecting a more intuitive interface, they had to use more time than expected and considered using the system a difficult job. As one of the MERCURY users described in an interview:

> It was new. In the beginning the whole thing was new. We tried to understand what it was. How can it help my job; how will it make my day better?[laughs] Then we understood that it would not be so easy and started using the system as it was described in the training sessions. (ALPHA User Interviews, 2004)

The main problem was the complexity of a typical transaction in MERCURY. For example, an average financial transaction required the MERCURY user to enter values into several fields over five different screens instead of one as it was in Logo. Therefore, they covertly continued to resist MERCURY and tried not to follow the instructions for use. Some people even tried to collect their entries over Microsoft Excel files and wanted periodic importing of those files into the system. However, managers clearly and repeatedly declared that the users had to "accept working with the new system or better leave the company" since "*changing MERCURY just because some users wanted it to change was not so easy*".

Actually, the main problem wasn't about making or not making changes on the external features of MERCURY, it was about changing the inherent logic of how to use the system. The described sequences of multi-screen use were actually designed to ensure the integrity of a financial transaction. The changes demanded by the users could make using MERCURY much easier but would decrease the controls inherent in the system, threatening the correctness of the accounting. Therefore, the users had to obey the rules of using MERCURY and started accepting the logic, as described by one of the accounting users:

> When I got used to MERCURY, I actually started liking it, especially when I could create fancy reports and do new analyses that were not possible with prior systems.(ALPHA Implementer Interviews, 2004)

While MERCURY users were having struggles with the implementation team, MINERVA users were trying to figure out their own routines of using the system, with informal trainings and coaching of trained peers. The informal approach to user training actually encouraged them to develop their own logic for using MINERVA. The implementation team was very accommodating with respect to the change requests as long as they did not harm other system components (Figure 5-2). These observations support the related proposition for ERP adaptation in ALPHA (See Table 5-7).

Table 5-7 Micro level observations in ALPHA

Proposition 5: ERP logics dispose ERP use by dominating users when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• Users had no option but use the system as implemented, since it wasn't easy to change MERCURY. • Integrity of a financial transaction could be damaged, if users did not follow the described sequences of MERCURY use. • MINERVA users were devising their own routines of using the system with the guidance of peers and informal training. • MINERVA changes that wouldn't be harmful for another system component were readily accepted.

5.1.8. Changes at the Micro Level

As described in the previous section, the MINERVA users had been providing some logic on using the system even in the beginning. Shortly after they became more familiar with the system, they started developing their own routines of using MINERVA, which were different from what had been prescribed to them initially. For example, instead of filling required fields on the screens, they started entering dots to make fake entries. Another example of novel use is that, small user groups started using some text fields on the screen for purposes different from what was intended in the implementation phase, to share different data fields amongst themselves.

When MINERVA users went too far in inventing novel uses of the fields in MINERVA, the MINERVA implementation team, made fundamental changes in MINERVA implementation to accommodate these changes. They either developed some new modules or significantly altered the existing modules for new uses.

For example, at one point in time, MINERVA users started assigning legal court cases as if they were IT equipment and attached related files as if they were equipment documentations, to be able to follow different legal actions going on at various locations in Turkey. The user, who invented this use, influenced others in his group to do the same for their own practices, which then became a de-facto standard usage for the specific team. In ALPHA, there appeared several teams of experts who applied the same scheme. With the emergence of such a use, other groups also followed this scheme and started organizing their files as if they were equipments of the related sites. When such changes in use started creating integration and performance problems, the users were asked to abandon parts of this usage. However, parts of this novel use, that could be accommodated within the limits of the existing system were accepted and became a legitimate use of MINERVA.

The nature of the transactions followed by MINERVA was significantly different than MERCURY. The functional sequences of using the system were not as critical as those of a financial transaction. Hence, the MINERVA implementation team could consolidate screens of basic transactions into a single screen. As one implementation team member described:

> MINERVA was made to accommodate the USA standards. It was suitable neither for us nor for ALPHA. So we modified it according to our standards and the local requirements during and after implementation. Now, you cannot find any single installation of MINERVA worldwide that is like what we have here (ALPHA Implementer Interviews, 2004)

Initially, MINERVA was designed to follow every device and its components with precise location information all over Turkey. For example, for a network device sitting in a system room in the Ankara office, hardware basis was recorded with the exact location of the system room and the exact location of the equipment within the system room. Furthermore, any additional hardware cards installed to the network equipment was further recorded specifying the identification of the slot the card was located in on the equipment. ALPHA designed and implemented MINERVA to keep track of and follow this information online for all their locations in Turkey. After users started using MINERVA, this logic had been followed for some time. However, keeping track of this information with so much precision created significant user resistance, since the tasks related with installing, replacing, and moving equipments became heavily involved data processing, which wasn't the case before. Rather than entering location-related information of equipments at one time, users started to collect this data in local files and later entered them in batches manually. However, the batching time got longer and some of the users actually started forgetting or ignoring to update the location data. This modification in system use, have accumulated reliability problems on MINERVA. Since, MINERVA implementation could not force the individuals to enter this data, batch data entry became a commonly accepted practice. Due to forgotten data entries, ALPHA started making annual asset counts to update the data on the each system.

On the other hand, for MERCURY, some of the users stopped using some of the side functionalities offered. Implementation team did not consider this behavior harmful or dangerous, since it did not influence any of the critical functions of MERCURY. However, this trend got only further, and users started ignoring many additional features, which were critically emphasized in the design and implementation phases of MERCURY. As one implementation team member described:

> XYZ functionality was initially planned for online usage. It was in fact, one of the key requirements defined in the design phase that each ERP vendor was asked to comply with. It took long hours to discuss the design and even a longer time to implement related functions to prepare the reports, screens, and everything.(ALPHA Implementer Interviews, 2004)

One user in accounting describes how she first stopped using this function online and totally ignored it later, as follows:

> In the beginning we were using it online. But after the first year, I decided to collect the data sheets daily and enter everything in the system later in batches. Then due to the daily rush, I started missing days. Now, I don't do it at all. I keep the data in Excel and import it in MERCURY whenever they want me to. Since no body insists on using the system online, this change does not create any problems for me. (ALPHA User Interviews, 2004)

In both cases, for MERCURY and MINERVA, users started making some minor changes in their use. These modifications got accumulated and even amplified over time. However when the accumulated changes started acting against the fundamental logic of using the system, either the new use influenced the logic or the modified uses were eventually abandoned to reconcile with the existing logics of system use. These observations support the related proposition for the ERP adaptation in ALPHA (See Table 5-8).

Table 5-7 Observations on Micro Level Changes in ALPHA

Proposition 10: When drifts in ERP use cannot be accommodated within multiple interpretations of ERP logics, ERP use modifies ERP logics through influence. If ERP logics cannot be modified, then drifts in ERP use would eventually recede and be abandoned.
• MERCURY users stopped using some of the side functionalities that were heavily emphasized during design and implementation. • Since this change did not threaten any critical function of MERCURY it was allowed within the existing logic of system use. • MINERVA users modified their logic of using the system shortly after they became familiar with the system and started storing some site-specific documents by creating valueless assets on locations. • Later this modified use created performance problems, reviewed by the implementation experts and partially prevented, but some documents allowed making the modified logics a legitimate use of MINERVA. • Although, users were asked to immediately enter any changes in asset information into MINERVA, they started making batch data entries, which the implementation team later accepted. However, users became neglectful later and ALPHA started making annual asset counts all over Turkey to update data.

5.1.9. Propagation of Changes to the Meso Level

The changes in use made MINERVA evolve into a site management platform, since more and more site related information and documentation had been integrated into MINERVA. Before those integrations, MINERVA had been referred to in ALPHA documents as an “asset management platform” representing the fundamental schema of the implementation. However, after the modifications in use, the user’s reference for MINERVA as a “site management tool” dominated the terminology. The implementation team switched from the term “asset management” to “site management” while referring to MINERVA. After that discourses in secondary sources regarding to MINERVA had also shifted to “site management” representing a change in ALPHA’s perception of MINERVA.

In addition to the changes in the users’ and the implementation engineers’ perceptions of MINERVA, some changes took place during the implementation. For example, the implementation team, influenced by the users’ habitualized use of MINERVA for site-related issues, transferred other site-related issues, such as recording site-related invoices for accounting, that were initially planned on MERCURY to

MINERVA. Moreover, MERCURY inventory module was canceled due to problems in use and site-related parts of inventory functionality were transferred to a new module of MINERVA. These changes required a new integration between MERCURY and MINERVA to enable MERCURY to import the related data from MINERVA, which was not prepared during implementation.

MINERVA was primarily used to follow manually opened, non-technical "trouble-tickets" regarding to sites, which are used to follow problems. Network-based technical problems were followed separately on the System Management Server (SMS) of Microsoft. Later, users suggested changing the implementation on MINERVA and influenced the implementation team to integrate MINERVA with SMS for an automatic opening of the technical trouble tickets on MINERVA.

However, the required changes for the new integration were not in the design and were carried out with minimal planning. The integration was developed without any prior analysis and carried out more or less, with a trial-and-error method. Therefore, the new functionality created performance problems in other MINERVA modules. In order to resolve these problems, the implementation team performed a total re-evaluation of the current situation and changed implementation schemas to avoid unexpected side effects of the SMS integration.

In addition to the "legal case" and "site maintenance" teams, the teams that follow up the site renting contracts with individual owners (private renting team) also wanted to use MINERVA. They influenced the MINERVA implementation team to integrate their processes into MINERVA.

MINERVA implementation engineers made a total re-interpretation of the previously unused MINERVA Measurement module by changing screens, labels, fields, and flows and by adding new fields, attributes, and reports. They made the old measurement module an entirely new one. Private Renting teams were very satisfied with the new module and they suggested it to other teams that deal with renting contracts with corporate owners (corporate renting teams). Corporate Renting Teams followed the suggestion and influenced MINERVA implementation engineers to modify the new module according to their own requirements. Interviews reveal that both renting teams demanded their integration into MINERVA, quite informally, during the tea talks and cigarette breaks and managed to influence the implementation team to enlarge the footprint of MINERVA.

Table 5-8 Propagation of changes from micro to meso level in ALPHA

Proposition 13: When ERP logics and ERP schemas contradict, they regulate each other with domination.
• Some MERCURY users did not use certain functionalities. Therefore some of the modules were postponed and cancelled. • Due to problems in use, some of the MERCURY functions such as workflow and human resources were moved to the best-of-breed independent applications. • MINERVA was an "asset management platform" but with alternations in its use, it is now perceived by the implementation team as a "site management tool". • Users' logic of "all information in one screen" dominated MINERVA schemas, changing the application implementation accordingly.
Proposition 8: When ERP use drifts significantly, it conflicts with and exerts influence on ERP implementation.
• MERCURY users stopped using some of the side functionalities that were heavily emphasized during design and implementation. • Since this change did not threaten any critical function of MERCURY it was accepted within the existing logic of system use. • MINERVA users modified their logic of using the system shortly after they became familiar with the system and started storing some site-specific documents by creating valueless assets on locations. • Later this modified use created performance problems, reviewed by the implementation experts and partially cancelled but some documents kept in the system, legitimizing the logics related the modified use of MINERVA. • Although, users were asked to immediately enter any changes in asset information into MINERVA, they started making batch data entries, which the implementation team later accepted. However, users became neglectful later and ALPHA started making annual asset counts all over Turkey to update data.

Although MINERVA increased its footprint significantly with the integration of new data sources and functions, preventive maintenance and resource planning modules of MINERVA could not be implemented. Users' logic of "we should enter all information in one screen" also dominated schemas, some screens of MINERVA increased from 10 to 50-60 data fields to enable users to enter all related information on one screen. Therefore the total number of screens significantly decreased, changing the application implementation accordingly.

At the same time, drifts in the use of MERCURY were not as extreme. However, MERCURY users simply rejected some functions and modules and insisted on not using them. This changed the implementation plans accordingly and some of the modules that were planned for implementation in later stages were postponed and cancelled. Some of the functions, such as workflow and human resources that were planned for implementation on MERCURY, were moved to the best-of-breed independent applications,

5.1.10. Changes at the Meso Level

The MINERVA implementation team almost always accepted changes requested by the users since "*they were not restricted by the software*" and they perceived these changes as "*a way to win users' commitment in using the software*". (ALPHA Implementer Interviews, 2004).

As they received and accepted more suggestions from users, they started to reconceptualize MINERVA as a platform for "site management". They even suggested that all other teams performing site-related functions to integrate their business processes and data sources in MINERVA. Therefore, other users asked the implementation team to also cover other business processes, which required them to keep complex Microsoft Excel workbooks and integrate the related data into MINERVA. As the implementation team incorporated such requests into the application successfully, more users placed similar requests about site management influencing the implementation team and their managers. As this trend progressed, MINERVA's implementation schemas changed to a "site management platform" at the meso level of ERP adaptation in ALPHA.

At this stage, ALPHA went one step further and enabled MINERVA power users to make simple changes to screen designs and started formally accepting the use of some data fields entirely for purposes that were not planned in the beginning. This further fueled the users' re-interpretation and changing of MINERVA.

The implementation team later transferred authority of decisions on all implementation changes to a specific technical unit, where majority of the MINERVA users are located. Since the operation and maintenance of MINERVA were handed over to this specific technical group, users became freer in changing the software according to their wishes. The technical unit made a contract with a third party software company and started developing a set of ALPHA specific add-ons and modifications on MINERVA for such enduring changes.

In the meantime, MERCURY implementation had reduced to a functional minimum and additional phases of implementation were postponed or canceled. Implementation schemas were modified and reduced into a subset that only covered what the users accepted, in order to "complete" the project. The implementation team turned into a maintenance team and started dealing with only day-to-day problems rather then implementing additional functions to the system. Some members of the implementation team returned to their previous positions in the organization and left the team.

Table 5-9 Changes at the meso level in ALPHA

Proposition 11: When drifts in ERP implementation cannot be accommodated within multiple interpretations of ERP schemas, ERP implementation modifies ERP schemas through influence. If ERP schemas cannot be modified, then drifts in ERP implementation would eventually recede and be abandoned.
• MERCURY implementation had reduced to a functional minimum. Schemas were modified and reduced into what was accepted and therefore "completed". • MINERVA schemas were turned into a "Site Management Platform" and they asked other site management related teams to get integrated with MINERVA. • Some power-users were given the authority to make changes on the user interfaces of MINERVA and non-proper uses of screens and fields were accepted. • A user division was given the authority to continue with the MINERVA implementation, as they deemed appropriate, with the help of a contractor.

Although the initial design and implementation for MERCURY included financial reporting, a manager in the finance department decided to purchase a different reporting system that imports data from MERCURY. Other managers in finance followed stopping to use the built-in reporting templates of MERCURY and started developing their own reporting templates. Currently ALPHA doesn't use any of the original reporting functions of MERCURY. It developed its own reporting infrastructure and canceled the reporting functionality of MERCURY implementation, which was considered to be critical in ERP vendor selection during the ERP design.

5.1.11. Propagation of Changes to the Macro Level

During implementation, especially before MERCURY went live, implementation issues, which seemed to be in contradiction with the schemas, were taken to the ERP Steering Committee that was made of macro agents, who initially decided on the specifics of the ERP design. Therefore, for significant alterations in implementation, the team took the guidance of designers in revising the schemas. This approach seems to have aligned the macro and meso level decisions in ERP adaptation and ensured the domination of ERP paradigms during the implementation.

Despite the initial comprehensive design for MERCURY, many of the modules that were initially planned have not been implemented in ALPHA. Some of the modules were cancelled and some others were postponed. Financial reporting, which was once used as a main source of justification for an ERP system, was taken out of the MERCURY Finance module and another application was purchased for reporting for investor relations.

The initial design required all information to be kept online in a very detailed manner for MINERVA. However, currently, the information on MINERVA is hardly up-to-date. Instead of online data entry and use, sub-contractors were hired periodically to make enterprise-wide asset counts and report missing assets and unreported location changes by updating the information on MINERVA quarterly. Such changes created doubts and questions regarding to the ERP systems, especially among the top managers. As MINERVA evolved into a site management platform, some of the fundamental financial functions such as depreciation, costing, asset bookkeeping were moved to MINERVA for site management.

When SMS integration with MINERVA created problems, the ERP Steering Committee, who had not held any meetings for several months, organized a meeting and decided on a complete analysis of the situation in MINERVA. The arranged audit team investigated the system and ordered cancellation of some of the changes they were going to make on the system according to user requests. Legal case files, which were entered to the system, were cancelled. The audit team considered it risky against confidentiality breaches, since the system was not designed to store such documentation. At this stage, ERP paradigms dominated this change as one top manager described:

> "It was an ERP application, not a document management or case tracking software. What do the legal case files have to do with asset depreciation, site inventory and maintenance management?" (ALPHA Designer Interviews, 2004)

Initially, MERCURY and MINERVA were planned to be tightly integrated software applications establishing a functional whole as the ERP backbone. However after years of adaptation, the two software became only loosely integrated, with off-line and batch integration at the data level. Trouble ticketing, alarm management, and depreciation integration were all modified and added to the initial designs of MINERVA, and the number of modules had also increased. Whereas, MERCURY had some custom built modules and reports were discontinued and their MINERVA counterparts were purchased instead.

Significant changes and module cancellations in implementation deviating from the initial design created doubts and questions among designers and other managers regarding the current status and viability of the ERP system on hand. Therefore, ALPHA again asked APOLLO, the management consulting company who worked during the selection and design, to make an enterprise-wide ERP post-implementation assessment and describe the areas that didn't fit "the objectives of the ERP currently in use in ALPHA". During its study, APOLLO reviewed the initial design, the implementation experience and the evolution of use in ALPHA and reported the areas, which did not match to the initial design. APOLLO reported that the extensive level of customizations and changes prevented upgrades for both for MERCURY and MINERVA. APOLLO also reported some "areas of opportunity" according to "recent advancements in the ERP arena". Together with APOLLO, macro actors of ALPHA decided to cancel some of the customizations and functionalities to enable software upgrades for both MERCURY and MINERVA. This study presents an example of how "updated" ERP paradigms work to dominate the existing ERP schemas and logics of ERP use, which had a potential to change the established institutional order around ERP technology and restart the ERP adaptation in ALPHA. At the time of the study, ALPHA started considering a new ERP project, to lay off MINERVA and consolidating the functionality on a newer version of MERCURY, which now also covers functionality offered by MINERVA.

Table 5-10 Propagation of changes from meso to macro level in ALPHA

Proposition 9: When ERP implementation drifts significantly, it conflicts with and exerts influence on the ERP design.
• Many of the MERCURY modules had not been implemented and the design was updated. Some functions were taken out of the scope to other applications. • The data in MINERVA was not up-to-date and the level of detail decreased. This influenced updating the ERP design and arranging annual asset counts. • MINERVA evolved into a site management platform, some of the fundamental financial functions about sites were transferred from MERCURY to MINERVA.
Proposition 14: When ERP schemas and ERP paradigms contradict, they regulate each other with domination.
• MERCURY related issues that contradict with ERP schemas were taken to the ERP Steering Committee, which ensured the domination of ERP paradigms. • ERP Steering Committee arranged an audit team and later ordered the cancellation of some of the changes schemas. Hence ERP paradigms dominated. • ALPHA ordered an ERP post-implementation audit from APOLLO, covering MERCURY and MINERVA to reassure domination of ERP paradigms.

5.1.12. Changes at the Macro Level

Although some of the changes on MINERVA were cancelled, many changes remained. It is observed that ERP designers accommodated these remaining changes by adhering to the "site management system" schema. In addition to that, in 2005, new modules of MINERVA were purchased for some additional financial transactions at the ALPHA sites. ALPHA top managers started describing "site management" within their descriptions of regular ERP functions. This cannot be observed in their prior descriptions. Even in some meeting minutes, some top managers argued that MINERVA became not an integrated enterprise system but rather an "amorphous dragon". However, such accounts were forgotten later. Macro actors of ALPHA, being very sure regarding to the merits of an ERP system at the beginning, have changed their expectations and perceptions of the ERP later and started stating their doubts regarding to the ERP concept (ALPHA Designer Interviews, 2004).

Table 5-11 Changes at the macro level in ALPHA

Proposition 12: When drifts in ERP design cannot be accommodated within the multiple interpretations of ERP paradigms, ERP design modifies ERP paradigms through influence. If ERP paradigms cannot be modified, then drifts in ERP design would eventually recede and be abandoned.
• Revision in the ERP schemas and contradictory problems created doubts and questions about the ERP systems especially among top managers. • Site Management, which was once denied as an ERP task by some of the top managers, was later accounted for as part of the ERP functionality. • ALPHA revised its perception of ERP from being "enterprise-wide" and "tightly-integrated" to be more receptive to the current state of the system.

5.2. Conclusion

ALPHA is a special case of ERP adaptation, where two different ERP technologies are concurrently adapted in connection with each other. Considering their structural properties, each ERP technology, namely MERCURY and MINERVA, represent different levels of hardness for organizational action. Observation of ERP adaptation within the same organization, enabled us to control the variability inherent in comparing two different organizations and evaluate the impact of hardness and softness of technology during technology adaptation.

5.2.1. Institutionalization of MERCURY AND MINERVA in ALPHA

After eight years of adaptation, both MINERVA and MERCURY reached a highly stable state and have institutionalized in ALPHA. However, ALPHA significantly diverted from the initial ERP paradigm that was shaped by the institutional environment.. For instance, in the "Project Objectives" presentations prepared in the beginning of the project, the most frequently referenced issues were enterprise-wide and tight integration with ERP technology. In those presentations, MERCURY was especially recommended for its advanced financial accounting and reporting capabilities, whereas MINERVA was proposed as a closely integrated part of the completely integrated ERP system. However, currently all of these are hardly true. MINERVA is not a closely integrated ERP module, but it stands almost as a separate ERP system and loosely integrated with MERCURY. Against the initial recommendation, MERCURY had its greatest problems in financials and most of its reporting functionality is not being used. The ERP system does not cover the whole enterprise, but rather stands as an accounting and logistics software. Most of the modules planned at the beginning (e.g. HR-Payroll, HR-Performance Management) as a part of ERP were cancelled and are now being handled by two other applications that are not integrated with MERCURY.

Nevertheless, the adaptation process made ERP paradigms, schemas, and logics consistent with each other. Emerging discrepancies between structural elements of ERP technology have diminished significantly, leading to the legitimacy of MERCURY and MINERVA among actors and hence the institutionalization of the ERP technologies in ALPHA. Actors in ALPHA habitualized their actions in relation with MERCURY and MINERVA. Users in particular are in a paradigmatic duality and not questioning the legitimacy and the functionalities of MERCURY. MINERVA users have habitualized the continuous re-interpretation of MINERVA functions and requesting new functionalities as part of their daily practice. Their actions implicate more a paradigmatic dualism with the structural elements and hence MINERVA is less institutionalized then MERCURY in ALPHA.

According to the RDT model, the institutionalization of MINERVA and MERCURY in ALPHA can be disrupted by several sources. The users actions regarding to ERP technology might "drift significantly" and "exert influence" on other levels of action, leading to decreased level of social integration. At some point, such "drifts in action" may "not be accommodated within multiple interpretations" of the ERP paradigms, schemas, and logics and may influence these structural elements to change, decreasing the level of system integration among them and partial de-institutionalization of technology due to increased structural contradictions, restarting adaptation. For example, MINERVA users can demand a very significant change in its functionality or MERCURY implementers may decide to implement a new module of MERCURY.

Another source that may re-start technology adaptation in ALPHA could be the structural contradictions between structural elements of ERP technologies in ALPHA and wider institutional context. For example, "ERP paradigm" in the wider institutional context may change, with the rise of ERP II, a new type of ERP or ERP vendors who prepare these technologies may impose some technical changes on the system and force upgrades. This is actually quite probable for both ERP systems, because, MINERVA has not been upgraded at all and MERCURY has not been upgraded since 2001. An upgrade means restarting a very significant adaptation, canceling some of the custom developments and returning most modules to their original states before the adaptation.

5.2.2. Limitations of the RDT Model in ALPHA

The RDT model has been very helpful in understanding, comparing, and contrasting adaptations of MERCURY and MINERVA in ALPHA over time. Differences between two technologies with respect to their hardness and softness produced meaningful results to understand the adaptation histories in ALPHA.

The RDT model can be further improved to take into account the temporal nature of the adaptation. Although ALPHA provided number of change requests for both ERP systems over time as a proxy measure of technology adaptation, the RDT model does not provide any propositions regarding to the temporal nature of the adaptation to interpret and evaluate this data.

Furthermore, at the stage where MINERVA implementation team transferred the authority for continuing implementation and modification of the ERP system to the user departments, users who were originally considered as micro actors in RDT, became meso actors. This is not incorporated in the RDT model.

6

TOTAL CUSTOMIZATION OF ERP TECHNOLOGY IN BETA CORPORATION

In this chapter, I describe the adaptation of an ERP software application in the BETA Corporation (BETA) and explain how BETA has gone through an adaptation while establishing its ERP infrastructure. First, I describe BETA and its ERP adaptation history. Then, I discuss the immediate and wider institutional context and the process of adaptation. I conclude with a theoretical discussion of the ERP adaptation in BETA.

6.1. BETA Corporation

BETA was established in 1987 as a 50-50 joint venture between a Turkish business group and a Belgium company. BETA produces steel cord for the tire industry and various types of wires for industrial and individual consumers. The foreign parent company of BETA is the world's largest independent producer of steel wires and cords with 65 plants in 21 countries worldwide. Therefore, in addition to its own production in Turkey, BETA imports and markets cords and wires from its foreign parent company and also exports part of its production to the parent company's other markets in the Middle East, the North Africa, the Balkans and the Turkish Republics of Asia.

BETA is located in İzmit, together with a set of closely integrated industrial manufacturers. Nearly 80% of all production of BETA is consumed by two large tire manufacturers who are in very close proximity to the BETA facilities in İzmit. For BETA, there is not much competition in the Turkish market since there is only one competitor, which is a large scale cord-manufacturer, established by an Italian company and is also located in İzmit and it serves mostly its own tire manufacturing at another plant.

BETA is best known for its quality related initiatives in Turkey. Its production lines have been certified under ISO 9002 Quality Management Systems and the company has been implementing “Total Quality Management” in its production and management processes since 1991. BETA has been a member of the European Foundation of Quality Management (EFQM) since 1994 and received the European Quality Award for small and middle-scale companies in 1997. Due to its history in quality management, continuous improvement, and participative management dominated company narratives and individual descriptions, and is frequently the subject of participant observation sessions and interviews. The ERP Adaptation chronology and a summary of the RDT model based dynamics of BETA are included in Appendix C.

6.2. BETA Corporation and ERP Technology

PHAROS is the ERP software application developed by a Turkish software company named BLIX , which is also a part of the same business group, and also owns half of the shares of BETA. PHAROS aims to provide an integrated solution to accounting, logistics, sales, and, human resources related functions in compliance with Turkish regulations as well as the international financial reporting standards. PHAROS has accounting modules (General Accounting, Accounts Receivable, Current Accounts, Banking, Fixed Asset, and Production Costing), logistics modules (Purchasing, Inventory Management, Inventory Accounting, Warehouse Management, Sales) and human resources modules (Human Resources, Payroll).

BLIX developed PHAROS as an enterprise ERP solution for small and medium sized organizations, by further improving a prior host-based accounting and inventory application. PHAROS is marketed as the first ERP solution in Turkey that has been awarded with the TS ISO IEC 12119 certificate for ERP software. PHAROS is not a web based application but works in a client / server architecture. Since web based applications became an industry standard, the technical architecture of PHAROS was partially outdated from the beginning of adaptation in 1999. Together with another client belonging to the same business group, BETA is one of the first two clients who implemented PHAROS in Turkey.

During 2000, BETA evaluated the worldwide ERP applications such as SAP R3, Oracle Applications, Baan, and also the local ERP applications such as Logo and Link. The top managers received a series of corporate and ERP functionality related presentations from each vendor.

In the beginning of 2001, BLIX Software Company approached BETA with their recently developed PHAROS ERP, which had not been implemented elsewhere previously. The developers of BLIX had almost finished developing PHAROS and they needed a beta-site for testing and proving the technology before its market launch and convinced BETA's general manager to use BETA for this purpose.

During the rest of 2001, BETA started implementing all the PHAROS modules across its functions. They established an implementation team, which studied the existing PHAROS functionality, BETA's business processes, and user requirements. BLIX was also asked to modify PHAROS in case of any discrepancies.

BETA finished implementation and started the pilot use of PHAROS at the beginning of 2002. The scope of PHAROS in BETA did not include production planning and shop-floor management, not only because PHAROS did not have those modules but also BETA was using specific systems developed by its European shareholder to implement its proprietary production related know-how. Although BETA planned to integrate these systems with PHAROS, this did not take place until the beginning of 2005.

6.2.1. The Wider Context

When BETA started to discuss adapting an ERP system, ERPs were already institutionalized in the manufacturing industry. Employing an ERP system had become a social and technical norm. The sister companies of BETA in its business group had either already started using ERP systems or were in the process of implementation. In early stages of ERP adaptation, BETA frequently "benchmarked" the sister companies to learn from their experiences. Furthermore, the company that was purchasing more than half of BETA's production was already in the process of ERP implementation and asking for some additional capabilities from BETA. This was a strong factor in favor of ERP adaptation.

In addition, there were plans for functional and financial consolidation in the business group. They were planning to integrate financial ERP accounting modules of the business group companies to have easier data flow and central reporting. McKinsey &

Company, a major management consulting company, advised to centralize some of the support functions to benefit from "economies of scale". Such a functional integration required an ERP-like application support at the end points for smoother flow and coordination between the central unit and subunits of each company.

Table 6-1. Observations on the wider context of ERP adaptation in BETA

Proposition 1: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with the normative, coercive, and mimetic forces in the wider environment.	
Normative	• Having an ERP system became an industrial norm in the manufacturing industry and in the business group.
Coercive	• The business group was planning integration of financial ERP modules for financial consolidation and reporting. • The business group was planning integration of some support functions
Mimetic	• BETA frequently benchmarked sister companies in the business group to learn from their experiences.

6.2.2. The Immediate Context

ERP related discussions in BETA could be traced back to early investigations and presentations to top management that took place towards the end of 1999. At that time, the company had been using stand-alone functional applications, complex spreadsheets, and small databases that were developed and maintained by users. Since those applications and user developments were not integrated, there were many problems with data quality and timeliness of information. For example, sales people could sell a discontinued product line or could commit to impossible delivery dates because of their stand-alone systems.

One of those stand-alone software applications was the accounting application developed by BLIX. However, all invoices, including the large shipments to two-big customers were manually prepared, creating significant error rates. Since the systems were also open to modifications of the volumes, unit prices, and total prices, there were problems with data quality and risks of internal fraud. Therefore, BETA technically needed an integrated application system.

BETA turned to BLIX when they decided to have an ERP system. Being a sister company in the same business group, BLIX had already been servicing BETA in information technology related issues and had earned the trust of the managers. Furthermore, BLIX was in need of a beta site for its recently developed ERP application and hence it not only offered a very low price but also promised to make every change needed "to fit their ERP software to BETA". This supported both BETA's ERP adaptation and BLIX politically, and quelled the general manger's doubts regarding to having an ERP system. Furthermore, PHAROS' cost to BETA was 1/20 of NEPTUNE's price proposal and was considered an extremely good price.

The general manager of BETA was very powerful. However he also needed social acceptance to his decisions like ERP selection which impact majority of employees directly. Participative decision-making had become a social corporate norm in BETA, long before the ERP project. BETA highly values participation of all managers in big decisions such as having an ERP system. Therefore, the general manager had to convince his subordinate managers of the PHAROS ERP. The participative decision making was also prevalent within the units of BETA, where unit heads share their decisions and views with their teams to discuss the contingencies of the issues on the agenda. Although this makes decision-making lasts a long time, it creates a socially receptive climate in the organization. It can be claimed as the reason for smooth adaptations in BETA in the case of large scale changes and new issues.

Table 6-2. Observations on the immediate context of ERP adaptation in BETA

Proposition 2: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with social, political, and technical organizational forces in the immediate environment.	
Social	• Participative decision-making style creates a socially receptive climate in BETA. • BLIX had been providing information technology related services to BETA and had earned the trust of BETA managers.
Political	• BLIX promised to make all the modifications on PHAROS to make it perfectly fit BETA. • BLIX belongs to the same business group and also offered PHAROS at a very low price.
Technical	• BETA had been using stand-alone functional applications creating technical problems.

6.2.3. The Macro Level

The ERP adaptation process at the macro level started with the selection of an ERP vendor and discussion of whether the ERP software should fit the company or the company should try to change itself to fit the ERP software in order to require minimal changes in the original system.

The evaluation team mostly agreed on purchasing NEPTUNE. However, the general manager of the company was highly critical of NEPTUNE in general. Stating that BETA "shouldn't try to fit into a software application", he openly said that the ERP software should be custom built or customized extensively to fit the company. He stated in several meetings that if they were to select NEPTUNE they wouldn't be able to change the system as they needed since NEPTUNE "would impose an iron cage" on BETA. In addition, he considered the license cost of NEPTUNE excessive. These discussions took more than a year and a complete consensus could not be achieved. Plurality of perspectives regarding to whether ERP should or shouldn't fit to the company and whether NEPTUNE is worth its cost remained afterwards.

During the design Phase, where the general requirements and the fundamentals of the ERP system had been determined, BLIX consultants were actively involved in the BETA design teams. Since BLIX was also knowledgeable in and actively implementing NEPTUNE, NEPTUNE consultants in BLIX also joined the analysis, design, and development teams at several stages of the development. As a result, BLIX and some of its clients including BETA, from time to time call PHAROS a "small NEPTUNE" due to minor functional resemblance to it.

Table 6-3. Macro level observations in BETA

Proposition 3: ERP paradigms dispose ERP design by dominating the designers when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• Differences in understanding ERP among macro-actors created a major controversy on whether an ERP system should fit a company or not. • The general manager was convinced that NEPTUNE could not be modified according to the requirements of BETA and would impose an "iron cage". • ERP design was made to perfectly fit the ERP solution to the current processes in BETA and PHAROS was selected.

6.2.4. Structuration of the Meso Level

The decision made at the macro level to fit the ERP system to the existing practices in the organization actually created a very different route for implementation. The implementation team was given the existing business processes and were asked to implement necessary changes to fit PHAROS exactly to the current situation. Hence the implementation work became a gap-analysis of PHAROS comparing to the existing business processes and modification of PHAROS accordingly.

Table 6-4 Macro-to-Meso level observations in BETA

Proposition 6: Designers contextualize ERP paradigms into ERP schemas with force.
• Despite the opposing views in the implementation team, top managers insisted on perfectly fitting PHAROS to the existing business practices without any changes.

6.2.5. The Meso Level

Following the ERP schemas forced by the macro actors in BETA, the implementation team, especially PHAROS engineers of BLIX did not have any option but to analyze the existing situation and modify the software accordingly. The implementation approach of BETA made the PHAROS ERP an almost infinitely soft technology, which could be changed to fit the existing operations. Hence PHAROS only provided a disciplinary framework for implementers to work on and this is what differentiated the implementation from custom software development.

The most significant implementation changes on PHAROS were made in the accounting transactions. In many ERP systems, such as MERCURY and NEPTUNE, transactions users perform create associated accounting records. Before implementation, PHAROS had the same design, where each transaction had a financial result that was directly recorded in the related company accounts. However, the existing business practices in BETA were entirely different. Only company accountants had the authority to create such accounting records. They demanded to keep the situation as it was and wanted BLIX to change PHAROS' internal structure.

Since the implementation strategy was to make the software fit the company, requested changes were accepted. The coding of PHAROS was changed so that each transaction that needed to create an accounting record was pre-recorded in a "pool". Accountants than evaluated the entries in the pool and created each accounting record manually by finalizing the pre-recorded entries into financial accounts. Since monthly cost calculations and allocations were very critical, the accountants had to empty the pool every month before cost calculations. However, what was developed in PHAROS was not exactly what the employees demanded. It was not possible to not record any accounting related user transactions. PHAROS provided an accounting discipline for user transactions. However, in order to satisfy the BETA accountants, PHAROS created a double-book keeping function, where every transaction was finalized in a temporary book, like any other ERP software and were later investigated by accountants and reconciled into the books.

Table 6-5 Meso level observations in BETA

Proposition 4: ERP schemas dispose ERP implementation by dominating the implementers when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• BETA interpreted PHAROS as a perfectly soft technology and changed totally. PHAROS only provided a disciplinary framework for developers to work on. • PHAROS disciplined BETA accountants and instead of simple book keeping, financial results of user transactions were first recorded in a temporary book and finalized later by accountants.

Another significant change performed was about modifying or deleting transaction records from the ERP databases. Usually in ERP systems, deleting or modifying records of previous transactions is simply not possible. Instead of making deletions, users are allowed to make reverse transactions and the history of all transactions including such modifications are kept in the database for further reference and reporting. PHAROS was also designed in this manner; however, the BETA implementation team had to change the software to incorporate the capability of making "corrections" (or modifications). PHAROS was changed and implemented so such that transactions could be updated until the middle of the next month, when accounts were closed. Although this change looked meaningless at first, the implementation team members convinced others that since the error rate was high, it would be difficult to use the system without this function.

6.2.6. The Micro Level

Since the system was developed targeting a perfect match with the existing transactions, BETA users required minimal training on inevitable changes in the existing processes and the user interfaces. When BETA users were introduced with PHAROS, they accepted it quite easily, since most of their objections had already been taken into considered. However, users still had to learn the structural properties of the new system, the organization of the screens, its basic functions, and commands.

Since ERP implementation was performed by modifying the software to exactly match existing business processes, minimal change had been introduced to the logic of daily practice in BETA. PHAROS implementation turned into a custom software application project and the existing PHAROS code just provided guidance for BETA.

Table 6-6 ERP technology at the micro level in BETA

Proposition 7: Implementers contextualize ERP schemas into ERP logics with force.
• The perfect match approach decreased the level of force required to create the ERP logics at the user side.
Proposition 5: ERP logics dispose ERP use by dominating users when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• Since ERP implementation was performed following the current processes exactly, it also matched with the existing logic of performing daily tasks before the system. Therefore, it became perfectly soft for users and disciplining effect was missing.

6.2.7. Changes at the Micro Level

BETA finished implementation and started pilot use of PHAROS in the beginning of 2002. During the first 10 months of 2001, both the old applications and PHAROS ran in parallel. During the parallel run period, the new system was presented to the key users and their managers and their requests were collected to change the system. Change requests and other problems were attended to and customizations were further developed during this period. In the 10th month of the parallel run, the legacy systems were stopped and the new system was put into effect. BETA had initially planned to continue with the parallel run during the last two months of 2001 and solve any problems that might have arisen during use. However, since no such problems had been observed, the old system was discontinued before the end of 2001. The financial year of 2001 was closed on the new system. This may also show that, BETA has achieved the goal of fitting PHAROS to existing practices.

Since users had been entitled to express their needs regarding to the screens, reports and use of the system during implementation and parallel run stages, they had nearly no complaints about the functional details of the resulting system after the replacement. Therefore, they did not require too many modifications after implementation was complete. In other words, when the logic of ERP use proposed by PHAROS had required a significant change in the current practice, users' influence made PHAROS change its structure accordingly, during the parallel run.

Among others, the sales department was mostly happy with PHAROS whereas the accounting department requested changes and adaptations mostly for designing new reports for the management and small insignificant modifications, as it is explained by one informant:

> Accounting department always had been using software, starting from the very early days. Hence, accountants always compared PHAROS with their early small accounting software and, even after so much modification, they criticized it for being harder-to use. However, the sales department never had any software, and lived with the problems of using multiple-disconnected spreadsheets. They became the most satisfied users of PHAROS when they compared it with having nothing. (BETA Implementer Interviews, 2004)

During the PHAROS implementation, in order to comply with requirements of BETA, the implementation team made some significant modifications on the system to enable some power users to delete or change some of the transactions that had occurred within an unclosed accounting period. However, this functionality created problems in use. During the implementation, the implementation team had planned to have only a few authorized power users eligible to have such a privilege. Initially, the privilege of being able to delete a transaction was only for the "power users" in accounting. However, the power users started sharing their PHAROS passwords to use the privilege collectively. Later logic of using this privilege turned into "any accountant could delete a transaction" and everybody in accounting had the rights to "correct" a transaction.

As PHAROS use progressed, reporting functionality in PHAROS was perceived as insufficient, because, users who were used to doing their own analysis and reporting on spreadsheets and databases could not do it on PHAROS. A development team prepared new reports according to users' descriptions. However, considering ad-hoc reporting needs in detail in such a development cycle seemed unacceptable. Hence, the information systems unit of BETA considered implementing a data warehouse technology and started evaluating "NEPTUNE Business Warehouse". 'The IS manager of BETA, who supported NEPTUNE at the initial stages wanted to implement and integrate "NEPTUNE Business Warehouse" with PHAROS, thinking that PHAROS could be replaced with "NEPTUNE" in the future".

Table 6-7 Observations on changes at the micro level in BETA

Proposition 10: When drifts in ERP use cannot be accommodated within multiple interpretations of ERP logics, ERP use modifies ERP logics through influence. If ERP logics cannot be modified, then drifts in ERP use would eventually recede and be abandoned.
• When the logic of ERP use proposed by PHAROS required a change in current practice, users' influence made PHAROS change its own structure instead. • The privilege of being able to delete a transaction was only for the "power users" in accounting. However, the users started sharing their passwords. • Later the logic drifted so that "any accountant could delete a transaction" and everybody in accounting had the rights to "correct" a transaction.

Currently, there are still some change requests regarding to the functionality of PHAROS. For example shipments without a price are not reported in PHAROS because it inherently requires that every shipment should have a price value greater than zero. However, shipments made for pilot uses, promotions or maintenance / repair are entered with zero prices hence cannot be shown on the reports of PHAROS. Currently the information systems department collects change requests on PHAROS annually and plans development needs for PHAROS and makes the budget for the coming year.

6.2.8. Propagation of Changes to the Meso Level

As described above, users increasingly demanded for ad-hoc analysis and reporting functionality from PHAROS. However, such functionality was not available and easy to build. Increasing demands from users influenced the implementation team to ask BLIX to create new data export mechanisms. The export mechanisms enabled users to transfer data of their choice to Microsoft Excel or Microsoft Access and create any report they wished on those applications. This change modified the implementation that aimed at elimination of user developed databases and complex spreadsheets. .

Table 6-8 Propagation of changes from micro to meso Level

Proposition 8: When ERP use drifts significantly, it conflicts with and exerts influence on ERP implementation.
• Users' demand for ad-hoc reporting influenced implementation to create data export interfaces for further analysis on Access and Excel • Common use of transaction correction functionality influenced the implementation team to create a transaction freezing function to limit corrections.
Proposition 13: When ERP logics and ERP schemas contradict, they regulate each other with domination.
• Exporting data for ad-hoc reporting dominated schemas to modify initial plans of eliminating stand alone databases and complex worksheets.

During use, more and more users in accounting were given rights to delete transactions to correct errors. Since accountants were using this function very frequently, some of them started printing and filing the screens for documentation and to follow the changes.

This created a series of risks, due to the need for tracing the corrections and data integrity was in danger. Influenced by this user behavior, the implementation team further devised "temporary term closing" functionality in PHAROS where the transactions were frozen after a few days limiting the correction rights to a limited group of users and all transactions of a month temporarily close at the end of the month. Until the accounting close of the month, only one power-user, the accounting manager, had the ability to correct a transaction.

6.2.9. Changes at the Meso Level

In 2004, the business group in control of BETA decided to centralize the purchasing activities of the business group. As a result, the majority of the purchasing department was transferred to the central purchasing unit. Only a couple of purchasing people were left in BETA to perform the urgent or special purchasing operations. Initially the transferred employees tried to use PHAROS remotely, however it did not work.

The significant change in the purchasing practice required significant changes in PHAROS and also required BETA to integrate its ERP system with the central purchasing unit's ERP. However, a simple integration was not possible because the coding schemes of the two systems did not match with each other. Therefore, BETA had to change its coding scheme on PHAROS and alter the ERP schemas. To solve the problem without changing its coding scheme, BETA appended the central purchasing unit's product codes to PHAROS. Existing codes were mapped to the new codes to integrate the coding systems.

Table6-9 Changes at the meso level in BETA

Proposition 11: When drifts in ERP implementation cannot be accommodated within multiple interpretations of ERP schemas, ERP implementation modifies ERP schemas through influence. If ERP schemas cannot be modified, then drifts in ERP implementation would eventually recede and be abandoned.
• Purchasing practice fundamentally changed PHAROS, altering the ERP implementation towards integration with the central ERP system. • Since product coding schemes did not match, BETA altered its ERP schemas and appended the product coding of the central purchasing unit to PHAROS.

Despite this solution, BETA faces mapping problems between the old and the new product codes. At times purchase orders of users did not trigger a purchasing activity in the central system. BETA devised a manual solution to this problem without making fundamental changes in the system. Whenever such a problem occurs, BETA asks for detailed purchase order reports from BLIX, which also provides administration and maintenance services. BETA performs detailed investigations on these reports to detect and resolve the problems.

6.2.10. Propagation of Changes to the Macro Level

Using two product-coding schemes concurrently was actually in contradiction with the ERP paradigm followed in ERP design, which requires one standard coding scheme for the whole company. One of the most daunting tasks of design was the development of a product coding scheme for PHAROS. Design team and top managers frequently mentioned that ERP was mainly for integration of different product naming and identification conventions that had been concurrently used in BETA previously. They were expecting that ERP would reduce them into a single coding scheme and an ERP design was prepared accordingly. However, after the integration with the central purchasing unit, the meso level schemas dominated the macro level ERP design paradigms. Power of the central purchasing unit facilitated this domination.

In addition, changes in PHAROS implementation encouraged users to export the data for further analysis and reporting outside. Because of multiple data sources created by data exports from PHAROS at different times, critical data and numbers in various management reports started to contradict.

Some of the managers ordered cross-checks of data obtained from PHAROS. Some of the calculations like production costs available both on production (alternative) systems and PHAROS were compared for validation. Inconsistencies were investigated and resolved mostly by changes on the PHAROS database, since the data integrity problems were attributed to problems in PHAROS.

Table 6-10 Propagation of changes from meso to macro level in BETA

Proposition 14: When ERP schemas and ERP paradigms contradict, they regulate each other with domination.
• Using two coding schemes concurrently for purchasing was in contradiction with the ERP paradigm, but later meso level schemas dominated the previous paradigm.
Proposition 9: When ERP implementation drifts significantly, it conflicts with and exerts influence on the ERP design.
• Data quality problems influenced the design and postponed integration of production systems, which were used for cross-checking.

ERP was designed to decrease the number of data sources in BETA and improve data quality. However, after years of adaptation, the situation did not change with respect to these objectives. The implementation-related problems started to contradict with the design. As the number of data sources increased and data quality problems were revived, the integration of production systems with PHAROS were postponed. Instead, production systems were used for cross checking the related reports taken from PHAROS and to locate problems.

6.2.11. Changes at the Macro Level

After years of adaptation, ERP paradigms in BETA have also changed significantly. Some of the managers requiring data warehouse functionality and related technical people were inclined to have NEPTUNE's Business Warehouse solution and replace PHAROS with NEPTUNE.

Since the general manager, who convinced BETA top managers to have PHAROS modified to fit the company has been promoted to a higher position in the business group, his close influence on daily company operations decreased. The information systems manager now discusses more openly that the company "should have to evaluate whether it should continue investing in PHAROS or switch to NEPTUNE for better and larger functionality". Despite the reporting functionality expected from NEPTUNE, NEPTUNE integration requirement from the central purchasing unit and the managers who wanted to have R3 instead of PHAROS at the beginning, one manager described the conditions of replacement:

> PHAROS can only change if BLIX stops supporting it or one of our big customers demands a specific functionality from us. If they asked us to provide supply chain integration over the Internet or digital data exchange that PHAROS cannot provide, then BETA would be forced to make changes in its ERP system. In that case, we should evaluate whether it is worth it to keep on investing in PHAROS or change it entirely. Otherwise, with the current General Manager reporting to our ex-General Manager, it is almost impossible to change PHAROS without an external motive(BETA User Interviews, 2004)

If BETA decides to replace PHAROS with NEPTUNE, paradigm of ERP might also change, since the current top managers are questioning their experience of perfectly fitting the software to the organization and say that it should have been the opposite. They complain regarding to PHAROS adaptation claiming that BETA did not learn anything during the process and did not improve much compared to its performance prior to ERP:

> It has been perfectly customized for BETA. However, compared to other ERP applications in the market, it did not provide new functionalities and capabilities to us. There is almost nothing new in it (BETA Implementer Interviews, 2004)

Table 6-11 Changes at the macro level in BETA

Proposition 12: When drifts in ERP design cannot be accommodated within the multiple interpretations of ERP paradigms, ERP design modifies ERP paradigms through influence. If ERP paradigms cannot be modified, then drifts in ERP design would eventually recede and be abandoned.
• Macro actors reached nearly a consensus that companies should use an advanced ERP package like NEPTUNE for a larger footprint and better functionality, • They also reached a consensus that ERP should not fit to the organization perfectly, but rather it can establish best practices and force organization to change.

6.3. Conclusion

BETA is a special case of ERP adaptation, where the managers of the organization deliberately selected to perfectly change and customize the existing technology according to the organization’s current organization of work and relationships. BETA management interpreted PHAROS as perfectly flexible and triggered a different adaptation process. However, the adaptation again showed a process where several structural elements of technology are maintained or changed in a recursive manner at multiple levels. Even in the case of perfect customization (free interpretation) of technology, human action is enabled and constrained by organizational and technological structures, where these rules and resources are also partly the consequences of previous actions or structures.

6.3.1. Institutionalization of PHAROS at BETA

Although we say that PHAROS in BETA has reached some level of institutionalization, it is still vulnerable to the influence of some actors. Due to the top management’s decision to follow the existing business practices and empower users to give directions to meso actors regarding to ERP implementation, users habitualized PHAROS quite fast and it gained a legitimate status. Although users in BETA are in paradigmatic duality, some of the meso actors, implementation team members, are questioning the legitimacy of PHAROS and still favor NEPTUNE over PHAROS. However, due to top-manager’s commitment to PHAROS and its existing design, they cannot modify the ERP schemas. Hence, feeling powerless to affect it, they are in syntagmatic dualism. Top manager’s ERP paradigm and contextualized ERP schemas and logics are coherent; level of system integration is high, leading to institutionalization of PHAROS in BETA

However, as described towards the end of this case, a decrease in the intensity of the force applied by the general manager may lead to de-institutionalization of PHAROS and re-start adaptation. Such an event may even replace PHAROS with another ERP technology.

Following these expectations, after I have finished preparing this case study, another visit to the case site revealed that meso level actors finally convinced new general manager to question the existing ERP paradigm in BETA and start evaluating NEPTUNE to replace PHAROS. This is further fuelled by BLIX's potential decision to discontinue PHAROS.

6.3.2. Limitations of the RDT Model at BETA

ERP adaptation in BETA had followed an "end-user" development scenario, where users became nearly the meso actors with the empowerment of the top management. The RDT model cannot explain how such changes in roles and authority among actors in an organization would affect the technology adaptation process.

However, the RDT model is still helpful in understanding the BETA case and PHAROS adaptation that has been taking place in BETA for seven years and in explaining the future of ERP adaptation in BETA.

7

THE POLITICS OF TECHNOLOGY ADAPTATION IN KAPPA CORPORATION

In this chapter, I describe the adaptation of an ERP software application in the KAPPA Corporation (KAPPA) and explain how KAPPA has undergone an adaptation process while establishing its ERP infrastructure. First, I describe KAPPA and its ERP adaptation history. Then, I discuss the immediate and wider institutional context and the process of adaptation. I conclude with a theoretical discussion of the ERP adaptation in KAPPA.

7.1. KAPPA Corporation

The KAPPA Corporation has been producing several chemicals and selling them to wholesale outlets and retail shops. The company was established in 1940s and has been among the largest commercial enterprises of Turkey. It was initially publicly owned and later privatized. Currently the majority of the shares of KAPPA belongs to two major holdings in Turkey. KAPPA has thousands of sales points all over Turkey with 55 office locations. Due to the non-disclosure agreements with KAPPA, further details of the industry and the demographics of the company cannot be disclosed.

After the privatization, the new owners transferred the general manager of a large European competitor in Turkey to KAPPA. Finance and accounting employees were recruited mostly from one of the owners' holdings and the rest of the top management, especially in the sales & marketing related positions were mostly recruited from other foreign competitors in Turkey. In the meantime the company moved its headquarters to Istanbul.

The majority of the existing employees were also dismissed and replaced after the privatization. Today, the company has nearly 1.100 employees, only 250 of which were with the company prior to the privatization. When the headquarters was moved, the majority of the employees working at the headquarters did not want to move to Istanbul and left the company. However, some of the employees in accounting and some key experts in information systems were persuaded to move to Istanbul, since they were critical for maintaining existing systems and operations. The ERP Adaptation chronology and a summary of the RDT model based dynamics of KAPPA are included in Appendix C.

7.2. KAPPA Corporation and ERP Technology

After a very long initiation period with heated discussions and debates, KAPPA decided to establish its ERP system. The company first prepared a “request for proposal” (RFP) for ERP consulting services and distributed it to major international management consulting companies working in Turkey. Proposals were collected from three of them and finally DELOS was selected as the ERP consultant of KAPPA for ERP requirements analysis, RFP preparation, and evaluation.

DELOS had worked with KAPPA for more than 6 months and prepared an RFP document. The proposals were evaluated and MERCURY was selected as the preferred ERP solution for KAPPA. The implementation started in June 2002 and finished in 18 months, 6 months later than expected.

7.2.1. The Wider Context

In the specific industry that KAPPA operates, ERP had a bad reputation. Many worldwide companies had undertaken large-scale ERP projects, spent large amounts of money, time, and effort but eventually had to face major problems that led some of them to failure. Therefore, industry experts mostly expect failure from an ERP projects. This normative expectation had worked against ERP adaptation and effectively blocked an ERP project for more than a year in KAPPA.

However, the industry in Turkey had been recently regulated and the players in the industry were increasing their pressure on KAPPA. Although KAPPA had the leading position in the industry, its international competitors started to increase their market share and profitability. The local competitors, on the other hand, all more recently established than KAPPA had newer systems. Hence, KAPPA expected the competition to increase and believed that the competitors had superior operations and supporting information systems. Despite the negative image of ERP projects, this expectation significantly effected KAPPA in its ERP decision.

In addition to these normative forces, several coercive forces were also operating on KAPPA for adapting an ERP system. The regulatory authority of the industry was demanding precise and timely reports from KAPPA regarding to its market and business operations. Furthermore, since some of the KAPPA shares were traded in the stock market, KAPPA had to make detailed disclosures regarding to its operations to the public. Moreover, two owner holdings also demanded better corporate governance and accurate reporting from KAPPA. These forced KAPPA to adapt an ERP system to be able to control its operations and to make timely and precise reporting to the public, its shareholders, and the regulatory authority.

Table 7-1 Observations on the wider context of ERP adaptation in KAPPA

Proposition 1: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with the normative, coercive, and mimetic forces in the wider environment.	
Normative	• ERP projects had faced significant problems and had a bad reputation, which effectively blocked ERP for more than a year. • KAPPA managers expected an increase in competition and believed that competitors had superior information systems.
Coercive	• The regulatory authority and the stock market required accurate reporting. • Holdings that own KAPPA demanded better corporate governance and accurate reporting.
Mimetic	• Other holding companies were implementing or already finished ERP their ERP projects. • All large companies in Turkey were implementing or already finished their ERP projects.

KAPPA also perceived additional forces in its wider environment. Being one of the largest enterprises in Turkey, it had identified itself as a leading corporate entity in Turkey in their market. However, all other large companies in Turkey that KAPPA compared itself with already had or had been implementing some ERP system. This created an image of KAPPA lagging behind the other large companies in Turkey. Moreover, most of the other companies of the two owner holdings also already had or had been implementing some ERP system. These comparisons with the other companies in same holdings or in Turkey also forced KAPPA to adapt an ERP system.

7.2.2. The Immediate Context

In addition to the forces in the wider context, the immediate organizational context of KAPPA also influenced the ERP adaptation. For example, the bad ERP reputation in the wider context influenced the KAPPA employees and almost nobody from KAPPA's departments wanted to work on the ERP implementation team. There was a general belief in the company that the ERP projects were most likely to fail. The KAPPA employees considered joining the project very risky for their careers and therefore, most of then avoided it. Although the ERP project required the business experts who were experienced in KAPPA, due to the social disinterest to the ERP project, most departments assigned their most junior members to the project. Social forces worked mostly against the ERP adaptation.

Political issues also operated on the ERP adaptation in KAPPA. First of all, since the management positions were divided between people supported by the two owner holdings, there were strong groupings and power games among managers. Managers that had powerful relations with either of the two holdings supported each other in corporate decisions. Therefore, many operational issues had the tendency to turn into a political dispute at KAPPA. The IT manager and his team that proposed the ERP project were influential and supported by one of the holdings. However, the other managers and directors, even those supported by the same holding, did not like the IT manager. As his deputy manager described in one of the interviews: "They did not like us. I didn't know why, maybe it was because we were treating them like dogs" (KAPPA Designer Interviews, 2004).

Although the IT manager could start the ERP project, he and his team were replaced in the beginning of implementation. The new IT manager was previously working as the consulting manager of another consulting company that was a competitor of DELOS.

Besides these, technical forces were also heavily affecting the ERP adaptation in KAPPA. The existing information systems of KAPPA were distributed over the entire country at the regional offices. They were mainly numerous standalone COBOL applications running on VAX mainframe systems, keeping their data on flat text files instead of a database. Most of the functional operations, even the complex financial ones such as budgeting, budget realization, and treasury were performed manually. Since the applications were not integrated and distributed, the consolidation of regional data for reporting was also performed manually and the state of operations could not be closely followed and controlled centrally. The management always had an approximate view of the actual operational variables; such as the level of sales and inventories. Due to the non-integrated and distributed nature, company assets were impossible to track over the numerous sites and projects of the company. Dealer and distributor credit control could not be performed effectively, causing the company to take extra risks from problematic dealers. Due to such problems, cost calculations and allocations of the products could not be performed; the company only knew its costs in approximation.

Table 7-2 Observations on the immediate context of ERP adaptation in KAPPA

Proposition 2: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with social, political, and technical organizational forces in the immediate environment.	
Social	• Due to the bad reputation of ERP, nobody wanted to work in the implementation team, believing that it was most likely to fail. • Due to the social disinterest, most units assigned their most junior members to the project.
Political	• The management team was divided between two owner holdings and strong groupings in the management emerged. • Most of the managers did not like the powerful IT director, who was supporting ERP.
Technical	• Legacy programs were disintegrated, distributed and overly problematic. They barely met the requirements. • Legacy programs were hard to support technically, without any documentation and there were few employees who knew them. • Project scope was very large due to geographical distribution of the company, making the ERP adaptation harder. • Later stages, KAPPA could not provide existing data for migration due to the technical problems of its legacy systems.

In addition to the above operational problems, which have direct business implications, there were other technical problems related to the information systems infrastructure. All of the company applications were written in the COBOL programming language and were very old. Since they were poorly documented or not documented at all, the new information systems management had a hard time in tracking down what application was running for what purpose. Maintaining the systems, making the necessary functional changes, and providing support to users had become very problematic. KAPPA had a hard time in preparing the system change requests originating from business needs and changing legal requirements in accounting. There were only a few employees who were knowledgeable on legacy applications and they were moved to Istanbul with the headquarters. Therefore, the company technically faced the necessity of changing its entire system and an ERP seemed a viable option to the information systems management in KAPPA.

The technical problems that pushed the ERP project had some adverse effects on the ERP project in later stages. KAPPA promised to make existing data available for migration at the end of implementation. However, due to the disorganized nature of the existing data in numerous applications, files and databases, KAPPA could not prepare the data for importing in time. For example, fixed asset data was available for migration one month after going live and frequently had integrity problems creating a need for manual updating of data in the ERP. This was a very complex process and created further problems in ERP.

7.2.3. The Macro Level

When the KAPPA IT manager explained his ERP plans with the top management, some managers showed resistance, because they had ERP failures in their former companies. The old accounting employees also joined the resisting managers and supported the existing processes. Later, the coalition against ERP became so strong that using the term "ERP" was banned in KAPPA. The IT manager could not convince the top management to proceed with an ERP project, and the design efforts were suspended for some time. Before the ERP project was resumed, the IT manager tried to convince the other managers of the necessity of ERP. However he couldn't communicate with the Finance director and the Accounting manager who were the main figures behind the ban against ERP. So the IT manager also continued his efforts at several levels of the organization to release the ban.

In order to increase social acceptance and exercise power, the IT manager started a number of other application projects with different names; such as Data warehousing (DWH), Customer Relationship Management (CRM), Supply Chain Management (SCM) and Sales Force Automation (SFA). It looked irrational and infeasible to carry these out simultaneously. As he explained during one interview, this was more of a strategic move. For these projects, he demanded participants from every department in the company. This way, he wanted to increase his direct reach to employees in other departments. His main intention was not actually bring these projects to an end. However, if some of them proceeded faster than he expected, he planned to integrate it later with a central ERP system. Among those numerous projects, only the DWH project had reached an end. All other projects lingered at the analysis step. However, participation in the analysis step of these projects "warmed them up" for an ERP project. One of his deputy managers described this move as:

> We had no alternatives but to go around the ban against ERP. Without using the name of ERP, we started all possible information systems projects congruently, to tear down the barrier. (KAPPA Designer Interviews, 2004)

A couple of months later, the Finance director, who was against ERP, was replaced by the General Manager at the suggestion of the owner holdings for a different reason. The Accounting Manager was still in his office, however he could not block the project any longer. Some people believed that the IT director used his power in the owner holding to dismiss him (KAPPA Implementer Interviews, 2004). The new director did not have any reservations against an ERP project in KAPPA. Hence, the ERP ban was released towards the middle of 2001 and the project officially started.

Although the director who was against ERP was replaced before the start of the project, the accounting manager, who was against ERP together with his team of accountants, was given the responsibility of ERP design. The General Manager wanted to make sure that the ERP design team considered his reservations and made him accountable for the success of the project. However, at the end of the design phase, he was also replaced due to his attitudes during the ERP design phase.

Table 7-3 Observations at the macro level in KAPPA

Proposition 3: ERP paradigms dispose ERP design by dominating the designers when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• ERP was troublesome and should be avoided. Hence ERP was banned. • ERP was designed to cover all company operations to get the "best practices" through the ERP system. Minimal customization was aimed.

During the ERP design, DELOS was requested to analyze all operations of the company with the intention of replacing all of the legacy applications. DELOS analyzed and documented all major business processes and listed their functional requirements for an ERP system with the participation of related managers of KAPPA. DELOS proposed that the ERP system for KAPPA should include as much functionality as possible to support the whole company and prepared an RFP document for distribution to the ERP vendors. DELOS was also requested to emphasize only the critical functional requirements, because the management stated that they were expecting the ERP system to provide them with worldwide operational best practices. KAPPA management did not want to change what ERP provides as best practices much, but rather wanted KAPPA to match the requirements of ERP. Hence, DELOS tried to focus on the critical functional requirements that are special to KAPPA.

The RFP was distributed to three major ERP vendors and the RFP questions regarding to the functional capabilities of the ERP systems were collected with a “technical proposal” as well as an additional, closed-envelope “financial proposal” covering the licensing and maintenance cost.

The consulting services of DELOS also covered analyzing the technical answers about functional requirements and prioritizing the alternatives in terms of their technical proposals. Two of the three alternatives were assessed as being almost equal at the end of technical evaluation; however, this result was not announced to the companies, formally.

Before opening the financial proposal of the two top-performing vendors in technical evaluation, KAPPA asked for their implementation proposals covering both their implementation costs and their proposed implementation partners. MERCURY offered DELOS as its implementation partner, whereas NEPTUNE was reluctant in cooperation with DELOS and offered alternative partners. After a very harsh price negotiation over the total cost, MERCURY made a very large price cut and was awarded the project.

7.2.4. Structuration of the Meso Level

The ERP design for KAPPA included sales, marketing, finance, manufacturing, and human resources modules, as suggested by DELOS. ERP design team and top management. They decided that implementation should be performed in two phases. In the first phase the sales, marketing, and finance modules were to be implemented and the second phase would cover the implementation of the manufacturing and human resources modules. This schema created the basis of the implementation structure.

KAPPA top managers who participated in the design wanted a very quick implementation, which would carry out only necessary modifications and customizations and mostly roll out of the prepackaged software. Therefore they set the project deadlines accordingly, making the implementation schedules very tight.

When the implementation team questioned this, the management team rejected their arguments and warned them that in case of late delivery of the project, they would not be entitled to their annual bonus payments and DELOS could be subject to contractual fines.

Table 7-4 Observations on how macro level actions are relating to the structural properties of meso level in KAPPA

Proposition 6: Designers contextualize ERP paradigms into ERP schemas with force.
• Top managers asked for a very quick implementation considering only necessary modifications and customizations, leading to very tight schedules. • Management rejected any arguments and warned them that in case of late delivery of the project, the implementation team may not receive the annual bonus payments or may be subject to contractual fines. • The schema of the implementation was to collect critical requirements, get their approval from the design team, prepare and rollout the implementation.

7.2.5. The Meso Level

The implementation strategy defined by the ERP schemas dominated the implementation team. Tight implementation schedules mostly disposed the nature of MERCURY implementation. Since the implementation team did not have much time to analyze the existing business processes in detail and decide on exact process designs, they had to accept what the informants said regarding to the necessity of a functional requirement. Furthermore, the ERP technology itself did not impose many hard constraints over implementation because of the nature of the ERP package. MERCURY is a configurable ERP technology, where by choosing several parameters in the software, the nature and flow of the business processes within the software can be controlled without changing its basic design. Therefore, the implementation team could not differentiate between the criticality of the functional requirements and start accepting what they had been told.

The KAPPA design team wanted to approve all the modifications and customizations, in order to control the changes performed during implementation. However, when they were consulted by the implementation team, the designers were slow in deciding on the modifications and mostly backed the stated requirements. Therefore, many new developments were implemented with the approval of design team. The implementation team considered that arguing about their necessity was more time consuming than actually implementing the developments.

Table 7-5 Observations on ERP technology at the meso level in KAPPA

Proposition 4: ERP schemas dispose ERP implementation by dominating the implementers when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• ERP schemas dominated the implementation team, hence they did not have much time to analyze the current processes in detail and decide on the implementation. • During implementation, KAPPA participants claimed numerous critical requirements and hence extensive customization was required. • Designers who were backing the requirements were slow in providing approvals that they required at the beginning.

With the implementation, MERCURY was integrated with the existing maintenance, sales, and logistics applications, which were developed before ERP. The order – shipment – billing – collection process was entirely moved to ERP, enabling detailed recording and following of the results. The books were developed for two currencies (USD and TRL) and receivable controls, interests, and valuations were kept in both currencies.

In the beginning of the implementation, the implementation team agreed with KAPPA to make at maximum 40 add-ons or software revisions and prepare150 custom reports and 10 workflows. The DELOS and MERCURY implementation contract was prepared accordingly. However, even at the end of first phase, the implementation team already prepared 86 add-on programs and software revisions and 67 custom reports and 5 workflows on the system. Therefore, during the second phase, no additional programs and software revisions were made. In order to compensate the difference, a number of reports to be prepared in the second phase was also decreased to 37.

7.2.6. Structuration of the Micro Level

Towards the end of the implementation stage, extensive trainings were given to users to describe how MERCURY would be used in KAPPA. A very large training team composed of 40 KAPPA employees was formed and given 960 hours of training on the program. Then, the training team made a tour of the country and trained all the ERP users, screen by screen.

The users had been instructed on what ERP was and how it should be used. The daily practices of users were designed and provided in training sessions and user manuals. These provided the basics of initial practice for the users.

Online and on time performance of transactions was emphasized in the training material, together with "use-case scenarios" that describe typical daily activities on the system and workshop type screen trainings. The implementation team, constantly and repeatedly gave the message that, after ERP, all data should be entered online and all the transactions should be made on the system.

User trainings heavily emphasized the side effects of batch-data entry and off-line accumulation of transactions for processing later. Being "fast and reliable together" was the key message in the training sessions. Users also stated that if they wouldn't follow the advised practice, the side effects of such a behavior would be "no good for themselves". Hence, the implementation team forced the users to follow the scheme without any exceptions.

Table 7-6 Observations on how meso level actions are relating to the structural properties of micro level in KAPPA

Proposition 7: Implementers contextualize ERP schemas into ERP logics with force.
• A very comprehensive training program for all of the users all over the country. • Detailed use-case scenarios and workshop type screen trainings to make users accept the logic of using ERP. • The users were asked to enter the data online and not to create any batch data entry which would "have serious side effects for everybody".

7.2.7. The Micro Level

When the implementation was complete, the system became operational, without any parallel runs with the old systems. The old systems were closed at night and the next day started with the MERCURY ERP system. The result was a total disaster. Despite the fact that the system went through extensive testing prior to operation, it faced a major operational break down. On the very first day, KAPPA could not print any invoices, perform any wholesale transactions or make any distributions to the retail shops. The truck drivers who performed the logistics on behalf of the customers were annoyed with the situation and argued with the KAPPA employees. Some of the truck drivers even broke the windows of wholesale facilities of KAPPA. KAPPA was able to resume its operations at the end of the first day and could not perform normally for several months.

Table 7-7 Observations on ERP technology at the micro level in KAPPA

Proposition 5: ERP logics dispose ERP use by dominating users when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• At the beginning of use, ERP was working much slower than what was planned. • Centralization of operational control and reporting was achieved. • Many of the manual tasks were eliminated with the ERP use.

Despite difficulties, in the use, KAPPA was capable of centralizing many of its operations and eliminated a majority of its manual transactions after ERP implementation. It followed budgeting, budget realizations, inventory levels, shipments, dealer credits centrally and online. With the use of MERCURY, KAPPA was capable of tracking its assets on the basis of locations and projects. Project and product costing was also based on production locations and products.

7.2.8. Changes at the Micro Level

Since the beginning of system operation the whole thing was a major disaster, since it created a lot of changes at the micro level. To resume normal production, the users had to devise new ways of performing the transactions without using ERP. Since opening of a typical screen took nearly 5 minutes, it was impossible to make any sales transaction using the MERCURY system.

Unlike what was instructed during trainings, they had to devise new logics of doing manual work, creating invoices manually and entering the job orders and related transactions at the end of the day. KAPPA could not solve the operational performance problem for several months and the users had to do business in their own ways.

However, this created further problems. Since all of the jobs were performed manually and entered into the system later, there were serious reconciliation problems. Like a bank branch, if reconciliation were not achieved, none of the employees were allowed to leave the sales offices, in order to be able to close up the daily accounting. However, this turned into a nightmare. KAPPA employees who were working in branches had a hard time in returning their homes at the end of the day. They had to work hard and late hours, to be able to finish data entry, find the problems, and correct them to achieve reconciliation of the transactions. The implementation team, who were trying to tune the system to improve performance, had problems with restarting the system, even after midnight hours, because many branch employees were working at those times.

Table 7-8 Observations on changes at the micro level in KAPPA

Proposition 10: When drifts in ERP use cannot be accommodated within multiple interpretations of ERP logics, ERP use modifies ERP logics through influence. If ERP logics cannot be modified, then drifts in ERP use would eventually recede and be abandoned.
• Since the sales locations had to complete reconciliation of their daily accounts, the users had to work very long hours every workday for 3 months. • Due to the slowness of the system, users had to devise new ways of using MERCURY. Unlike the instructions, they had to make batch data entries for 3 months. • Some of the user groups devised Microsoft Excel workbooks for recording manual transactions and data entry methods to MERCURY.

While trying to devise manual forms of working without application support, some of the users started recording their transactions over several Microsoft Excel workbooks. Some of them even devised some basic data entry controls and reconciliation functions in those workbooks. They used these workbooks to generate reports to prepare for later data entry into MERCURY. Some user groups even went further and standardized these workbooks among themselves. Although, those workbooks had limited controls over data entry, they maintained the new logic of using the system and sustained it, since the system was not working properly. Other than those changes due to performance problems there was not much re-interpretation of use or change requests at the user side that requires changes in logics of ERP use, since, most of the user requests were taken care of during the implementation.

7.2.9. Propagation of Changes to the Meso Level

Apparently, the speed of using ERP was considered unacceptable and the implementation team started performance tuning and changes in of MERCURY system. Some of the processes and technical customizations were cancelled to speed up the system. Hardware and processor sizes were changed and more powerful hardware was ordered to improve the system performance. After 4 months, the system performance reached to an acceptable level.

Prior to system use, no parallel running of the legacy systems together with MERCURY was planned. However, since improving the system's performance took so long and the users switched to manual, unsupported ways of working, some of the legacy systems were restarted to provide some support to critical users.

Table 7-9 Changes at meso level in KAPPA

Proposition 8: When ERP use drifts significantly, it conflicts with and exerts influence on ERP implementation.
• Speed of using ERP was not acceptable and implementation was changed to increase performance. • Users had to perform everything manually with user-invented methods, the schemas of implementation changed and some of the legacy systems resumed. • User groups who devised new uses with Microsoft Excel influenced the implementation team to integrate their Excel files with MERCURY.
Proposition 11: When drifts in ERP implementation cannot be accommodated within multiple interpretations of ERP schemas, ERP implementation modifies ERP schemas through influence. If ERP schemas cannot be modified, then drifts in ERP implementation would eventually recede and be abandoned.
• ERP schemas were updated to allow Excel workbook integrations as legitimate forms of data entry.

Many user groups, who devised new logics of using Microsoft Excel to record and prepare manual transactions for data entry, influenced the implementation team to integrate their Excel files to MERCURY. Since there were a great many problems, the implementation team could not reject such demands and established Excel integrations and additional data integrity methods on MERCURY interfaces. When the performance problem was resolved, implementation team revised related system documentation to describe Excel integrations as a proper and legitimate form of data entry to the MERCURY system.

7.3. Conclusion

This case study illustrates the RDT model, emphasizing the importance of the political engagement of structural and agency components of technological adaptation at multiple levels in the shaping and reshaping of a technology in an organization. It demonstrates how the shaping and reshaping of the ERP adaptation covers power based interactions between structural and agency-based aspects at multiple levels. Such an interaction is clearly a part of ongoing political debates and relationships in an organization. Individuals or collectives may exert power on others as a political process to reflect their interests and perceptions of the technology to accommodate individual or group interests.

7.3.1. Institutionalization of MERCURY at KAPPA

The case emphasizes the importance of building coalitions, developing and sustaining networks of relationships and removing "blockers" if possible or incorporating them into the change process towards institutionalization. All these political facets are part of the technology adaptation in organizations. However, besides political action, structural and technical aspects have also played their part in KAPPA towards institutionalization of MERCURY.

Structural aspects of MERCURY and organizational context of KAPPA also had a significant role in the adaptation process. During the political debate in the early and later phases of adaptation, agents in KAPPA reflected on what they were doing and they created structures for lower level of agents, deliberately as part of their political agenda, following the RDT model propositions.

Besides political moves, there were also unintended consequences of action in KAPPA, where individuals created and sustained organizational practices on MERCURY that eventually became institutionalized, and in doing so maintained, took part, or modified the structural properties of MERCURY at their level. Hence, despite the heavy political action at the early stages of adaptation, MERCURY became institutionalized, gaining legitimacy with increased level of coherence between paradigms, schemas, and logics. Actors in KAPPA are in paradigmatic duality, and currently unthinkingly enacting rules imposed by the structural elements of MERCURY.

7.3.2. Limitations of the RDT Model at KAPPA

The RDT Model has been very helpful in understanding and explaining adaptation of MERCURY in KAPPA. Political focus of the RDT model actually helped to detangle the power-based contests and conflicts among actors and structures. However, the RDT model provided very limited help in understanding how the technical properties of MERCURY acted as a powerful vehicle for promoting preferences of the designers and implementers in a “neutral” fashion to the rest of the employees. Therefore, the RDT model can be further improved to have a closer look at the technical aspects and its value-laden relationships with actors at various levels of the organization.

8

ERP ADAPTATION IN A STABLE GOLIATH: ZETA CORPORATION

In this chapter, I describe the adaptation of an ERP software application in the ZETA Corporation and explain how ZETA has undergone adaptation while establishing its ERP infrastructure. First, I describe ZETA Corporation and its ERP adaptation history. Then, I discuss the immediate and wider institutional context and the process of adaptation. I conclude with a theoretical discussion of the ERP adaptation in ZETA.

8.1. ZETA Corporation

ZETA is the largest tire manufacturer in Turkey and the sixth biggest tire manufacturer in Europe. Manufactured tires are marketed in 33 countries worldwide, primarily in Europe with 2,700 sale points. The company was originally established in the 1970s by a large business group in Turkey, under the license of an American company. The company initially was a 100% Turkish investment and had a different name at that time. Production started in 1977 at the factory with a covered area of 90,000 m2 and the sales extended to 60 provinces in Turkey with 186 dealers. Until 1988, the Company produced tires under its own brand with a product range covering tires for passenger cars, trucks and buses to farm and off-the-road vehicles.

In 1988, the company established an equal-share joint venture with a large Japanese tire manufacturer and was renamed as “ZETA Corporation”. Following this joint venture, a new manufacturing plant was completed in 1990 using Japanese tire manufacturing technology. The new joint venture and the new plant investment are described as “a new concept of management, production, and quality which has been as important as the advanced in technology and new machinery” in the corporate website. After that, the joint venture became a primary example of Japanese technology and management techniques in Turkey, favoring the consensus-based decision-making, at least among managers. ZETA implemented many Japanese management techniques including quality circles and total quality management. The ERP Adaptation chronology and a summary of the RDT model based dynamics of ZETA are included in Appendix C.

8.2. ZETA Corporation and ERP Technology

8.2.1. The Wider Context

There were strong contextual factors supporting an ERP system in ZETA. Both the Turkish business group and the Japanese company, who own ZETA, had been using ERP systems extensively for their material requirements planning, production planning & execution, financial reporting, and consolidation purposes. Just before ZETA announced its decision to start an ERP project, the Turkish business group had asked ZETA to comply with the new financial reporting standards that would make financial reporting in the business group easier. However, the business group did not specifically required ZETA to have an ERP system for the specified reporting standards, but "there was an expectation in the business group that ZETA should have its ERP system soon, being that it was one of the largest companies of the business group" (ZETA Senior Management Interviews, 2004).

Table 8-1 Observations on the wider context of ERP adaptation in ZETA

Proposition 1: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with the normative, coercive, and mimetic forces in the wider environment.	
Normative	• New financial reporting standards to comply for the business group. • Major shareholders had ERP systems, expecting the same.
Coercive	• Large customers wanted to connect their ERP systems with ZETA for data exchange.
Mimetic	• Sister companies had been implementing ERP with BLIX corp. as their consultant.

Customers of ZETA have been mostly large-scale car manufacturers. They have purchase large volumes making up nearly 80% of all production. Car manufacturer customers had already implemented their ERP systems and were asking business-to-business connections between their ERP systems and ZETA for data exchange. In addition to these forces, almost all the sister companies in the business group had been implementing or already had various ERP systems, mostly with the consulting of the BLIX Company, which was also a member of the same business group.

8.2.2. The Immediate Context

ZETA had been an "institutionalized company" (ZETA ERP Designer, Implementer and User Interviews, 2004) where there were strong traditions and rituals which were established after long years of experience. The average tenure of employees was 12.3 years which had been considered as very high compared to other industrial companies (ZETA Senior Management Interviews, 2004). Furthermore, the company had been focusing on Total Quality Management (TQM) for many years and consensus decision making had been an established norm within the company, which made the company a very stable place, where even minor changes had not happen frequently.

In addition, ZETA had been a very formalized company. Job descriptions were written in a very detailed manner and employees and workers had been rotating between critical jobs and operations in order to maintain availability of backup employees for those positions. The human resources manager described this as a way of "decreasing variability and being able to replace people more easily" (ZETA Senior Management Interviews, 2004). Hence the company operations were very well-defined and documented.

ERP technology related discussions intensified in ZETA in the beginning of 2000. Just after management offices had been moved from the headquarters in Istanbul to the plant site in İzmit, a series of "search conferences" had performed. The topic was "how to sustain growth and leadership" and aimed to point out areas of problems collectively. One of the issues that were raised in these search conferences was improving ZETA's "deficiencies in Information Technology".

After the recognition of information technology and systems as a deficient area, the company conducted another search conference with a special focus in technology. This time ZETA information systems people together with participants from ZETA sales and production departments were invited to the search conference together with several outside consultants, including some ERP consultants from BLIX.

The second search conference focusing on information technology resulted in a recommendation to acquire an ERP and E-business technologies. These search conferences, actually informed their participants that changes should be expected in information systems infrastructure of ZETA. Although the company decided on an ERP and E-business collectively during search conferences, rumors of the ERP project were heard before the formal announcement. Especially the accounting department where employees were very concerned, because they heard that, "a new software project would make life easier in the offices and there would be downsizing in the accounting department" (ZETA ERP User Interviews, 2004). During the study, the managers also stated that they were expecting NEPTUNE to decrease the need for the number of people working in ZETA; however that did not happen after NEPTUNE implementation (ZETA ERP Designer Interviews, 2004).

The workers' union was very strong, and once effectively blocked the initiation of TQM activities in ZETA. To start TQM, ZETA had to convince the union that TQM was also for the benefit of the workers. Since it was still powerful, the union had a potential to resists ERP, if they considered it a threat for ZETA workers. However, the union did not show any resistance, since they deemed the implications of ERP in the shop floor workers negligible.

BLIX Corp., being the member of the same business group and serving ZETA for information technology for a long time, had been politically very strong within ZETA. ZETA did not consider any alternative company as their implementation consultant and asked directly to BLIX to specify ERP software that would fit them best. After some discussions, NEPTUNE was selected, in the middle of 2000, because it was the only large-scale ERP application that BLIX previously implemented and was experienced with. The political power of BLIX actually made the ERP selection easier for ZETA and supported ERP adaptation.

Before the ERP, ZETA had been operating materials requirements planning, order management, and accounting processes using old custom-build application software on the MVS operating system. These legacy systems were old and there were problems in making developments and connecting with new systems to increase functionality.

ZETA was not selling directly to end-users but to car manufacturers and tire dealers, most of which were working with both ZETA and brands of other manufacturers. Especially dealers always had the flexibility to turn to the competitor if they did not receive good service from ZETA. During the second search conference, one of the advantages ERP would provide was identified as "being able to give fast response to dealers". ERP was expected to improve the experiences of dealers with ZETA Corporation for ordering, payment, and reporting.

Table 8-2 Observations on the immediate context of ERP adaptation in ZETA

Proposition 2: Institutionalization of the technology paradigms, schemas, and logics in an organization is positively related with social, political, and technical organizational forces in the immediate environment.	
Social	• Very stable and formal company with infrequent changes. (-) • Some users believe ERP could make them loose their jobs. (-) • ERP had been expected among the employees.
Political	• ERP was considered to have negligible influence at the shop floor by the worker union • BLIX supported selection of NEPTUNE ERP without any questioning in ZETA.
Technical	• Functional development and business partner integration problems for the existing systems. • Need for being responsive to dealers.

8.2.3. The Macro Level

BLIX had performed a series of presentations on ERP to ZETA top managers. One of the key concepts that were accepted during those presentations was that "to have maximum benefits the ERP shouldn't be customized much". The designers were also thinking that NEPTUNE process templates are the "best-practice" models and ERP should work as "the central data repository to provide timely and correct data" (Zeta Designer Interviews, 2004).

ERP Design for ZETA had been prepared using these high-level principles. NEPTUNE process templates were taken as "best-practices" and ZETA business processes were intended to be changed accordingly. Since the ERP was understood to be the central data repository, it was decided to replace all related legacy applications and cover the entire company including accounting, finance, sales, production planning, purchasing, operations, reaching towards the shop-floor.

Table 8-3 Observations at the macro level in ZETA

Proposition 3: ERP paradigms dispose ERP design by dominating the designers when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• NEPTUNE process templates were "best-practice" models and ZETA should change to fit NEPTUNE. • NEPTUNE is the consolidated and central data repository that provides timely and correct data for the whole company.

8.2.4. Structuration of the Meso Level

Using the principles and the high level design, implementation blueprints of NEPTUNE were prepared after an extensive analysis of the business processes and functional requirements by BLIX consultants in July 2000. Later, a full-time internal team was established with experts from various functions. The internal team, which had been trained by BLIX on NEPTUNE, briefly joined the analysis of the existing business processes.

Towards the end of 2000, the team finished analyzing the existing business processes and designed schemas of "to-be" processes for the implementation of NEPTUNE. They were mostly the same with the "manufacturing" process templates of NEPTUNE with minimal changes to fit NEPTUNE best-practices to the local context. As it is described by one implementation team member:

> We were told not to change NEPTUNE, wherever possible. Actually asking a major customization required the approval of the IT manager and even CIO! I did not try to convince them of any other options while preparing new business processes (ZETA ERP Implementer Interviews, 2004).

Table 8-4 Observations on how paradigms are contextualized into schemas

Proposition 6: Designers contextualize ERP paradigms into ERP schemas with force.
• Initial designs were followed and minimal changes planned since each major change had to be explained and agreed with senior managers.

8.2.5. The Meso Level

In the ERP industry, NEPTUNE ERP had been known to be a harder technology, compared to other leading ERP software (META Group, 2002). Instead of making detailed functional customizations, NEPTUNE ERP recommends configuring the existing business process templates available. NEPTUNE ERP had many alternative ways of configuring the existing process flows; however changing the process flows fundamentally is not advisable. Therefore, the job of the implementation team was only to select between numerous alternative configuration options available to change the nature of the business processes in NEPTUNE. Therefore, the implementation schemas and business process templates prepared during design according to available business processes in NEPTUNE had dominated the implementation team.

Table 8-5 Observations on ERP technology at the meso level in ZETA

Proposition 4: ERP schemas dispose ERP implementation by dominating the implementers when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• The process designs prepared according to NEPTUNE business process templates were strictly followed. • Product definitions and software integrations were performed according to the ERP implementation schemas.

The team implemented NEPTUNE, following the prepared designs and available business processes. Bill-of-Materials that described structure and ingredients of a product and its sub-assemblies on NEPTUNE were defined very precisely for every product. To follow the processes on NEPTUNE, an inherent order-production-confirmation schema was set up in the software, where every order was followed by a production order according to a schedule or user interaction and confirmed to be closed at the end of the process. Reporting schemas were prepared according to the current structure of the accounting plan.

8.2.6. Structuration of the Micro Level

As implementation progressed, the changes in the daily business processes became evident to users and managers in ZETA, before the system became operational. Like most of the other ERP systems, operational transactions with a financial result, such as purchasing or sales, had automatically created their respective accounting records. Most probably provoked by the accountants who were feeling themselves in danger of loosing their jobs, users in several departments started complaining regarding to "the responsibility of creating an accounting record". Several key users from various departments, such as sales, finance and budgeting, argued that this would cause problems in company accounting and operations. The resistance also continued after the system became operational. However, since it was impossible to change this fundamental functionality in NEPTUNE, the users were forced to follow this change. Unlike the prior practice, the new logic required the automatic creation of the accounting records from the transaction data entered by the users. Therefore users who performed transactions with financial impact had to enter data correctly on their screens since any errors would cause flawed accounting or lead to tedious correction tasks. This had created an initial anxiety in using the NEPTUNE system. Some users again asked for this to be changed on NEPTUNE. However, they were forced by their managers to use the system because it was very fundamental in NEPTUNE. Therefore, the new logic of using the ERP system had conflicted with ERP implementation.

The NEPTUNE ERP implementation finished and the system became operational on January 1, 2002. Before starting with the new system, extensive formal training sessions were carried out to teach users how to use the system. Every user had to attend at least a two-hour training program, to make ZETA users ready to use the new system. ZETA planned to have a pilot-run period, and run both NEPTUNE and legacy systems in parallel to observe and solve any problems during use.

Table 8-6 Observations on how meso level actions are relating to the structural properties of micro level in ZETA

Proposition 7: Implementers contextualize ERP schemas into ERP logics with force.
• Despite initial resistance, users were forced to accept that the NEPTUNE ERP system automatically creating accounting records for some transactions. • Operational data should be handled with care on the screens like financial data, changing the logic of ERP use.

8.2.7. The Micro Level

Despite the general positive earlier expectations, significant operational problems had arisen when NEPTUNE ERP system became operational. The situation was very problematic, despite being trained extensively, users had many problems in using the system correctly. As one user described:

> They told me this screen is for this, that screen is for that, enter that number here, this number there. However, I couldn't understand that was such a tedious job. When the time came, I simply couldn't follow the new pattern of working, and so do many others (ZETA ERP User Interviews, 2004).

Users could not switch their pattern of working overnight. This was partly expected, by the implementation team, and the situation was expected to improve over a few days. However, it did not improve after several days. Instead, users started asking for more and more changes to the system, claiming that their tasks could not be performed that way, leading to hard discussions regarding to the performance and the capabilities of the implementation team and NEPTUNE. The required change was so big that a majority of the employees got into fierce discussions with the implementation team. After a few days, some of the users continued with the new processes on NEPTUNE. However some employees rejected using it and continued with the legacy systems. Such a partial use was totally unacceptable and could cause a total failure of NEPTUNE project. Therefore, non-accepting users were forced by their managers to use NEPTUNE as instructed but also were asked to report their fundamental change requests.

Users in various departments of ZETA demanded numerous changes in NEPTUNE. The overwhelming volume of change requests blocked the implementation team and developers could not analyze, design, and develop most of the change requests, some of which were also in conflict with each other. In order to resolve the situation, several meetings were organized that brought together all parties that required a change regarding to each transaction in NEPTUNE. The implementation team and consultants from BLIX also attended these meetings. The team and the request owners discussed the nature of the changes, agreed on the priorities of the change requests and planned the changes in NEPTUNE accordingly. Later, they explained that the majority of the change requests were not feasible on NEPTUNE and the users were convinced to withdraw most of their change requests. After resolving operational issues on NEPTUNE, the implementation team progressed with an attempt to resolve reporting issues on NEPTUNE. There were also many report design requests from users. Later, users were also convinced to withdraw or to delay some of their report design requests. After this temporary settlement with the users, the old MVS system was closed down and NEPTUNE modules became the primary system for its operations.

Table 8-7 Observations on ERP technology at the micro level in ZETA

Proposition 5: ERP logics dispose ERP use by dominating users when the subject is a hard ERP technology and disciplining them when the subject is a soft ERP technology.
• The amount of required change created resistance among employees, but they were forced by their managers to use and also report their change requests. • The implementation team later convinced request-owners to withdraw or delay their requests, claiming they were infeasible

8.2.8. Changes at the Micro Level

After MVS were closed and NEPTUNE became the primary system, it created a sense of project success amongst the implementation team members, since the problems reported were also dropped, as described by one implementation engineer:

> We were done. After days and days of quarrels, and meetings, everybody accepted using the system as we designed it. It was a hard changeover, but we thought that we were finished (ZETA ERP Implementer Interviews, 2004).

Despite the initial positive expectations regarding to the successful completion of the project, a new line of problems started to appear from another group of users, workers. Workers were asked to enter job orders and completion progress in their terminals, which they tended to postpone until the end of the shift. Sometimes, workers could not enter the data at the end of their shifts and transferred it to the next shift worker at the same location. Therefore, the data about the shop floor was late by 1 - 2 shifts. Since the workers' union was quite strong, the management tried to solve this problem with hiring some data entry contractors and placing them around the shop floor. However, employing contractors to perform data entry criticized by the union was later dismissed by the management. They could not force the workers to enter data on time, either. Hence, having shop-floor data 1-2 shift late was accepted and users were informed to consider shop-floor data with this reservation.

Table 8-8 Observations on changes at the micro level in ZETA

Proposition 10: When drifts in ERP use cannot be accommodated within multiple interpretations of ERP logics, ERP use modifies ERP logics through influence. If ERP logics cannot be modified, then drifts in ERP use would eventually recede and be abandoned.
• Workers started entering shop-floor data late. ZETA could not solve the problem and accepted to have shop-floor data 1-2 shifts later.

8.2.9. Propagation of Changes to the Meso Level

During implementation of NEPTUNE, the purchasing process had changed and an additional control step added. Previously, all purchasing orders were approved by the purchasing department. However, with this modification, the new purchasing process on NEPTUNE required an approval of the requesters' immediate manager. The change is accepted by users and the managers, as a "measure to implement better controls on expenses" (ZETA User Interviews, 2005).

Table 8-9 Propagation of changes to meso level in ZETA

Proposition 8: When ERP use drifts significantly, it conflicts with and exerts influence on ERP implementation.
• A more complex workflow was demanded by management for purchasing and sales orders which required acquiring a new NEPTUNE module.
Proposition 13: When ERP logics and ERP schemas contradict, they regulate each other with domination.
• Complex flows deemed as necessary and initiated on paper forms, which were used before NEPTUNE... • The implementation team had taken those processes out of NEPTUNE and manual integration was required. • Later, some other flows also followed the scheme and switched to paper, just like their original flow before NEPTUNE.

However, as users continued using it, they demanded a more complicated, risk-based flow. Depending on the volume and the type of the purchase, approval of a higher level manager would also be required in addition to the immediate manager of the request owner before purchase orders were sent to the purchasing department. However, this process was complicated and required purchasing another NEPTUNE module, which was not available to the implementation team. However, users deemed such a flow as necessary and returned to the prior paper forms. The ZETA implementation team could not convince the users to use the existing flow. Therefore, it was decided that these flows be taken out of NEPTUNE. The Implementation team agreed with the users for manual entry at the beginning and in the end decided on paper-based for flow of accounting and data integrity purposes. Later on, the same scheme was also applied to sales orders, where depending on the risk level of the dealer, an appropriate sales manager had to approve selling to that dealer.

8.2.10. Changes at the Meso Level

Around August 2002, some of the shop-floor transactions in NEPTUNE were interrupted, since the work-in-process inventory went down to zero, although there was enough work-in-process inventory on the shop-floor, sporadically NEPTUNE could not complete some production related transactions, due to lack of inventory and recorded such transactions in incomplete tasks logs. The problem was considered to be partially because of shop-floor data being 1-2 shift late. Since, there should have been enough buffers on the shop-floor and the problem had just emerged recently, the implementation team decided to analyze the technical causes of the problem.

While analyzing this problem, the implementation team discovered that due to the nature of the production process, the actual material use in production was not as clear-cut as it was described in BOMs on NEPTUNE. For example, while producing one type of tire, if the worker was not satisfied with the quality of the work-in-process, (s)he could scrap the material and use it for some specified other tires in the future. There were actually some pre-defined quality limits on the amount of scrap that could be used in another tire. Using the scrap material as the raw material in some other tire created problems in following the material consumption with NEPTUNE using BOMs.

First, the length of incomplete tasks log was not large. An administrator was allocated to investigate those logs and manually complete them. In addition the work-in-process inventories, side-inventories were counted and manually updated on NEPTUNE weekly, in order to resolve misalignments due to scrap re-use. However, the problem was not solved and incomplete tasks log kept increasing. To solve this, ZETA increased the number of stock-counts at the shop-floor to 3 – 4 times each week.

At the beginning of 2003, the incomplete transaction problems caused a production interruption. The interrupted and uncompleted transactions hid the fact that an important raw material was actually in short. In order to not stop the production, ZETA imported a large amount of (60 tons) chemicals that was vital for production by air cargo, at significant cost to the company.

The large cost of the incident attracted the attention of the top management and the board of directors. The implementation team and BLIX consultants were called to explain the causes of the problem directly to the board of directors and general manger. After a hard meeting, it was decided to implement a scheme that modifies volumes in bill-of-materials dynamically with some expected scrap-reuse rates, considering the nature and the composition of the short-term production plan. However, such a solution was considered as infeasible in NEPTUNE. Therefore, ZETA decided to increase stock levels of some of the items in order to not have another production interruption. ZETA also decided to hire other consultants to analyze the problem and propose alternative solutions.

The implementation team then decided to cancel following the work-in-process inventory and production at the shop-floor with NEPTUNE. Related implementations and developments were cancelled and the shop-floor was treated as a black-box. Data was entered into NEPTUNE at the beginning and at the end of production, sometimes 1 – 2 shifts late. This change solved the problem by decreasing the scope of NEPTUNE design. However, after this, the implementation team went further in influencing the design and cancelled the order-production-confirmation schema and related business processes in NEPTUNE. An add-on that automatically processed the incomplete transactions log and completed them to avoid the possibility of further operational problems was set up.

The implementation has started with the intention to implement the NEPTUNE blueprints to create a single system for the company. However, after the problems in use and changes in the implementation, middle managers of different groups, such as production and sales resisted to consolidate their systems into NEPTUNE, which were planned to take place in phase two of the project. SPECS and TIME systems were recently implemented and MICRON implementation had actually started just before NEPTUNE. Therefore, the system owners rejected to salvage their systems, before their economical and technical end-of-life and declined to replace them with NEPTUNE.

Meantime, ZETA decided to acquire Manufacturing Execution System (MES), which connects to production lines directly to collect data and control the production facilities. In the beginning of 2004, implementation of MES started. Just as other systems that NEPTUNE was integrated with, MES was also planned to be in loose integration with NEPTUNE, only sending its data to NEPTUNE for reporting purposes.

Table 8-10 Changes at meso level in ZETA

Proposition 11: When drifts in ERP implementation cannot be accommodated within multiple interpretations of ERP schemas, ERP implementation modifies ERP schemas through influence. If ERP schemas cannot be modified, then drifts in ERP implementation would eventually recede and be abandoned.
• In order to update NEPTUNE data with actual situation, shop-floor counts planned first as weekly then almost daily. • Later, temporary adjustments on BOMS according to the short term production plan attempted in implementation. • However, NEPTUNE schemas could not be modified to enable this and hence the implementation change had to be abandoned. • The order-production-confirmation schema was cancelled and planned level of inventories increased.
Proposition 9: When ERP implementation drifts significantly, it conflicts with and exerts influence on the ERP design.
• In order to avoid re-occurrence of significant implementation problems, some design items have changed significantly. • Following of the production and WIP inventory cancelled, shop-floor started to be considered as a black-box.

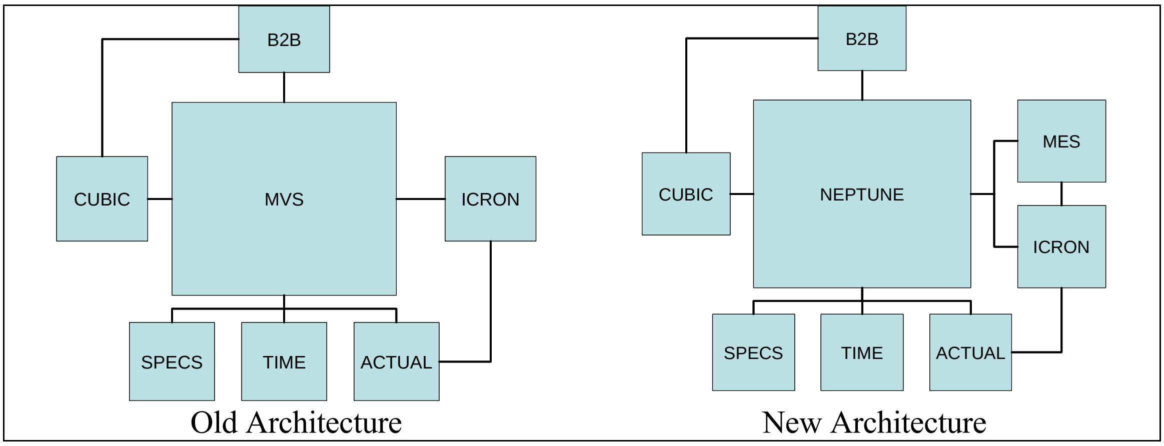
Hence, the ERP paradigm being a central system that would replace legacy systems was significantly modified, due to changes in the ERP schemas. Legacy systems which were used for several different purposes and integrated with the old MVS system were designed not to be replaced with NEPTUNE but to be integrated with NEPTUNE replacing their old integration with MVS.

Table 8-11 Propagation of changes to macro level in ZETA

Proposition 14: When ERP schemas and ERP paradigms contradict, they regulate each other with domination.
• The ERP paradigm of being a central system replacing legacy systems was significantly modified, due to the cancellation of order-production-confirmation schema making it a central reporting medium, rather than an operational system.

In the middle of 2004, a workflow application was purchased and some of the other business processes were also taken out of NEPTUNE, since then it became a less-operational system and the number of active users significantly decreased. Towards the end of 2004, ZETA decided to recalculate the number of end-user licenses. Due to decreases in scope, the number of end-user licenses decreased by 90 users and those end-user licenses were sold to a sister company in the business group, which was starting to implement NEPTUNE.

Figure 8-1 Information systems architecture in ZETA



Currently NEPTUNE is not used for production planning and does not replace any other legacy systems other than MVS, but only consolidates data from several sources for reporting. Hence, NEPTUNE, became the financial accounting software and the central reporting medium of ZETA, which is not only very different compared to initial ERP paradigm and design but also quite different from the prepared schemas and implementation of NEPTUNE. Although it was initially planned to consolidate all legacy systems into NEPTUNE, centralizing the information systems architecture, the resulting architecture were not much different from the original state (See Figure 8.1).

Table 8-12 Changes at macro level in ZETA

Proposition 12: When drifts in ERP design cannot be accommodated within the multiple interpretations of ERP paradigms, ERP design modifies ERP paradigms through influence. If ERP paradigms cannot be modified, then drifts in ERP design would eventually recede and be abandoned.
• NEPTUNE was initially considered as operational software. However, changes in its design influenced macro-actors understanding of ERP. • Initially the focus had been on operational integrity and consolidation of legacy systems for the whole company. • Lately, the focus was on reporting integrity and central data repository for related functions.

8.3. Conclusion

The ZETA case provides a useful demonstration of how the shaping and reshaping of the technology adaptation (in this instance ERP technology) involves interaction between conceptions and artifacts of technology at multiple levels. Such an interaction is clearly a part of an ongoing social dynamic and an organizational context. While human action is enabled and constrained by organizational and technological structures, these rules and resources are also partly the consequences of previous actions.

8.3.1. Institutionalization of NEPTUNE at ZETA

In the ZETA case, action during the technology adaptation process has been situated within a manufacturing company where structural components are rather durable. Hence, at the end of the adaptation, while NEPTUNE becomes finally institutionalized after a series of "crises", it did not trigger any major changes in the way work and systems were organized. Usually the initial structures have been maintained, and technology related change remained as a façade, replacing only one central system, without many changes in the way work has been organized. In this sense, NEPTUNE became institutionalized in PHAROS, leading to a paradigmatic duality among the actors.

In the case of ZETA, rigidity of the adaptation was directly related with ZETA Corporation's immediate context and the structural features of NEPTUNE ERP technology. This was further supported by a stance among the employees that stressed the necessity of stability and consensus in order to maintain working relationships. In this sense, the attempts to institutionalize ERP were partly rejected in favor of the existing set and state of relations to maintain the stability of ZETA with structural properties of the organization and political action of the individuals. ZETA employees resisted to change or questioned the new work arrangements, as a direct social consequence of the structural properties.

In this example, the substance of technology was also shaped the process and outcomes of adaptation, the ERP technology itself. However, the technical properties of NEPTUNE, not only dominated individuals by enabling and constraining their action, but also it acted as a powerful vehicle for promoting preferred options of the designers and implementers in a “neutral” fashion, even though the process was politically charged and shaped by a range of social and political factors and assumptions. Although the process started in a participative manner with “search conferences”, both NEPTUNE technology and the approach of ZETA management and the implementation team, provided little opportunity to users to participate in discussion earlier over the design, implementation, and modification of NEPTUNE system. Designers and implementers attempted not to open NEPTUNE adaptation to interpretative debate.

However, the collective resistance to maintain the status quo and further technical problems which are also indirectly related with the employee resistance necessitated the debates around NEPTUNE. Macro and meso level agents also treated the interpretive suggestions selectively and requests coming from higher levels of management were applied whereas, other request owners were rejected claiming technical infeasibility. Although NEPTUNE may appear as fixed and determined, the lack of interpretive flexibility is not determined structurally but is part of the political process of adaptation, which became clearer with the selective and fundamental changes performed in NEPTUNE “in order to solve technical problems”. Therefore, this case illustrates that the substance of technology adaptation overlaps and interacts with the political process and structural context in the shaping and reshaping of a technology and an organization.

8.3.2. Limitations of the RDT Model at ZETA

This case study illustrates the RDT model, emphasizing both the importance of structural components and artifacts of technological adaptation. The RDT model has been helpful in understanding and explaining adaptation of NEPTUNE in ZETA. The case study shows that the rigidity and flexibility of the adaptation process is more a consequence of the intertwined relationship of action and structural components of technology adaptation, represented in the RDT model.

Similar to the situation in KAPPA, the RDT model provided limited help in understanding how technical properties of NEPTUNE, acted as a powerful vehicle for promoting preferences of the designers and implementers in a “neutral” fashion to the rest of the employees.

9

RECURSIVE DUALISM OF TECHNOLOGY: A PROCESSUAL PERSPECTIVE ON TECHNOLOGY ADAPTATION IN ORGANIZATIONS

In this dissertation, our goal was to develop a comprehensive understanding of how technology is experienced and the way technology adaptation unfolds in organizations. I aimed to better understand and explain how different technologies are locking organizations in particular logics and patterns of practice and at the same time, how a technology is enacted to unlock and destabilize established logics and practices in organizations. I present a literature review on technology adaptation in organizations and consider the process both as structuration and institutionalization of technology. I devised the RDT model analytically using institutional and structuration theories of organizations and selected the case research strategy for the empirical evaluation of the RDT model, which are presented in several case studies in Chapters 5 through 8 for ERP technology adaptation in organizations.

Deployment of large-scale information systems in organizations, such as Enterprise Resource Planning (ERP) software applications, has been a major trend over the last decade; however, there is also a lack of understanding as to what the adaptation of these ERP software applications in organizations involves and how they evolve over time. Therefore, I selected ERP as the case technology to empirically study the RDT model considering impacts of such systems on individuals, organizations.

In this chapter, an overall restatement of the RDT model and its theoretical basis including propositions derived from the RDT model is offered. The chapter also summarizes and compares the case studies according to the RDT model propositions, which are introduced in chapters 5 through 8. In addition to this, contributions of this dissertation to the accumulated knowledge in Organization Studies and Operations

Management fields are presented together with a discussion of limitations of the research method and design of the study and an exploration of directions for future research.

9.1. Adaptation of ERP Technology in Organizations

In this study, I have investigated ERP Adaptation in five different cases in four different organizations. In ALPHA, two different ERP technologies were adapted with two different adaptation strategies; however, both ERP packages evolved differently to achieve different results than had been planned. While, MERCURY decreased its footprint significantly with numerous problems and "crises", MİNERVA evolved from being an asset management platform and become a site management platform of ALPHA, while users were almost completely free to adapt the software according to their wishes. BETA Case is similar to MERCURY case in ALPHA, since the adaptation was mostly ruled by the micro actors to make the software fit existing business processes, who were supported by the general manager, who did not want to be constrained with the limits of a packaged software application and forced the implementation team to modify PHAROS, as per users' requests. KAPPA case was characterized by heavy conflicts between agents and significant political action in the organization around ERP adaptation. Whereas, ZETA case was an interesting example, was a very stable organization attempted to change by using ERP adaptation. The cases represent polar organizational situations for the study where I make use of the RDT model to better understand and explain ERP technology adaptation.

9.1.1. Structural Context of ERP Adaptation

The RDT model incorporates several forces in the structural context of ERP adaptation and considers the wider context and immediate context of technology adaptation in two similar propositions.

9.1.1.1. Wider Context

The first proposition of the RDT model considers the wider context of technology adaptation and argues that favorability of normative, coercive and mimetic isomorphic forces are positively related to the ERP adaptation. Table 9-1, 9-2 and 9-3 summarizes the normative, coercive and mimetic forces observed in cases. Since, all cases took place in a

Turkish business context; the wider context is expected to be similar across cases. However, since some of the organizations have different contextual relations, some of them also fall under the influence of different forces. Having an ERP system became norm both for ALPHA and BETA. However, the same norm turned into a negative issue for KAPPA, where the ERP technology had a bad reputation in KAPPA's industry. Ownership and stakeholder expectations also normatively influenced ERP adaptation in ALPHA, BETA and ZETA (See Table 9-1).

Table 9-1 Normative forces observed in case studies

ALPHA	• Having an ERP system was the industry norm. • Stakeholders had been expecting an ERP system. Later, some of them integrated their systems for data exchange.
BETA	• Having an ERP system became an industrial norm in the manufacturing industry and in the business group.
KAPPA	• ERP projects had faced significant problems and have a bad reputation, which effectively blocked ERP for more than a year. • KAPPA managers expected an increase in competition and believed that competitors had superior information systems.
ZETA	• New financial reporting standards to comply for the business group • Major shareholders had ERP systems, expecting the same.

Being in the same business context is most clear in coercive forces, where the companies had to follow similar legal and regulatory rules, especially for ALPHA and KAPPA, since their industries are more regulated, compared to other cases. business groups who own the majority of the shares also coercively forced the cases to have an ERP system in BETA and KAPPA. It was also an issue for ALPHA. However, for ZETA, major customers were the coercive force for the organization to have an ERP system (See Table 9-2).

Mimetic forces were also noticed in the case studies which were mainly motivated by the organizations desire to manage uncertainty involved in ERP adaptation. Each company acknowledged that most of other companies that they compare their organization were working with an ERP system, and indicated this as a factor for their decisions related to ERP adaptation. ALPHA also made formal site visits to other companies in the same industry in Europe; whereas all other cases were mostly influenced by their sister companies (See Table 9-3).

Table 9-2 Coercive forces observed in case studies

ALPHA	• Legal and regulatory requirements of precise and timely reporting of financial results and operational metrics • Later, with significant fines due to reporting problems supported ERP implementation to overcome some barriers. • A large shareholder wanted to integrate its ERP system. When the shareholder had an option to increase its shares, related phase of ERP project had restarted.
BETA	• The business group was planning integration of financial ERP modules for financial consolidation and reporting. • The business group was planning integration of some support functions
KAPPA	• The regulatory authority and the stock market required accurate reporting. • Holdings that own KAPPA demanded better corporate governance and accurate reporting.
ZETA	• Large customers wanted to connect their ERP systems with ZETA for data exchange.

Table 9-3 Mimetic forces observed in case studies

ALPHA	• Site visits to European companies in the same industry and taking them as role models during the adaptation. • Largest competitor's ERP announcement increased the speed of decision making in ALPHA. However, in order to differentiate itself ALPHA switched to the alternative ERP vendor.
BETA	• BETA frequently benchmarked sister companies in the business group to learn from their experiences.
KAPPA	• Other holding companies were implementing or already finished ERP their ERP projects. • All large companies in Turkey were implementing or already finished their ERP projects.
ZETA	• Sister companies had been implementing ERP with BLIX corp. as their consultant.

9.1.1.2. Immediate Context

Immediate context represents the local structural context and covers most situational factors of an organization. Similar to the wider context, the RDT model posits that the favorability of social, political, and technical organizational forces are positively related with ERP adaptation. Table 9-4, 9-5 and 9-6 summarizes the social, political, and technical factors organized in case studies.

Expectations of agents represent significant social forces for ERP adaptation in all of the cases. Regardless of the actual situation, social expectations mostly enabled and constrained the organizational action around their ERP adaptation. This worked against the ERP adaptation in KAPPA where macro users' expectations effectively blocked ERP adaptation for some time. In ZETA and ALPHA, these expectations regarding to ERP were also related to job security issues. While in ALPHA, users did not feel any uncertainty about these issues. In ZETA, some of the users thought that the ERP may make them loose their jobs and acted to keep their positions in the organization and influenced ERP adaptation to accommodate their way of working (See Table 9-4).

Table 9-4 Social forces observed in case studies

ALPHA	• Existing applications did not meet the user expectations. • Strong expectation among people that the "status-quo" had to change. • ERP had not been considered in relation to savings in headcount hence no employee anxiety had developed about job security.
BETA	• Participative decision-making style creates a socially receptive climate in BETA. • BLIX had been providing information technology related services to BETA and had earned the trust of BETA managers.
KAPPA	• Due to the bad reputation of ERP, nobody wanted to work in the implementation team, believing that it was most likely to fail. • Due to the social disinterest, most units assigned their most junior members to the project.
ZETA	• Very stable and formal company with infrequent changes. (-) • Some users believe ERP could make them loose their jobs. (-) • ERP had been expected among the employees.

Political forces clearly influenced the ERP adaptation in all of the cases. Organizational groups that were supporting or rejecting ERP established informal coalitions to coordinate their actions in ALPHA and KAPPA. Whereas in BETA and

ZETA, the implementation consultant company were the same and its relations with the general manager and existing relationships with the organization, being a sister company, also significantly supported the ERP adaptation (See Table 9-5).

Table 9-5 Political forces observed in case studies

ALPHA	• Two strong groups within ALPHA (Finance and IT) demanded ERP for various reasons. • Finance manager wanted to control spending and operations in the IT department but the IT manager did not want to be controlled by Finance.
BETA	• BLIX promised to make all the modifications on PHAROS to make it perfectly fit BETA. • BLIX belongs to the same business group and also offered PHAROS at a very low price.
KAPPA	• Management team was divided between two owner holdings and strong groupings in the management emerged. • Most of the managers did not like the powerful IT director, who was supporting ERP.
ZETA	• ERP was considered to have negligible influence at the shop floor by the worker union • BLIX supported selection of NEPTUNE ERP without any questioning in ZETA.

Technical forces represent the technical conditions of the organization. Most organizational analyses overlook the technical aspects of the organizational setting, leaving the issue to the operations management field. The disciplinary division, prevents developing a comprehensive understanding of the technology phenomena in organizational settings. The RDT model considers both the substance of the technology and the technical aspects of the organizational situation. In all cases, problems and insufficient capabilities due to the disintegrated nature of the prior applications were noticed (See Table 9-6).

Table 9-6 Technical forces observed in case studies

ALPHA	• Previous problems in tracking, controlling, and coordinating its technical infrastructure, equipment inventory and related financial accounts. • Later, ALPHA switched to MERCURY on January 1st, 2000 to survive against the Y2K software digit problem.
BETA	• BETA had been using stand-alone functional applications creating technical problems.
KAPPA	• Legacy programs were disintegrated, distributed and overly problematic. They barely met the requirements. • Legacy programs were hard to support technically, without any documentation and there were few employees who knew them. • Project scope was very large due to geographical distribution of the company, making the ERP adaptation harder. • Later stages, KAPPA could not provide existing data for migration due to the technical problems of its legacy systems.
ZETA	• Functional development and business partner integration problems for the existing systems. • Need for being responsive to dealers.

9.1.2. Disposition of ERP System

According to the RDT model, structural aspects of technology dispose their respective organizational action. The ERP paradigms dispose ERP design actions and artifacts of macro actors, whereas ERP schemas dispose ERP implementation actions and artifacts of meso actors. Respectively, ERP logics of micro actors dispose actions and artifacts of ERP use. The RDT model differentiates between levels of hardness of ERP technology; when the subject is a hard technology, the structural elements of ERP technology dominates the actors. However, for softer technologies, the interpretive flexibility is higher and structural elements of ERP technology acts more as a disciplining factor and the actors have more options to perform within the structural bounds determined by the technology.

9.1.2.1. Macro Level

Our observations across the cases for macro actors reveal that the general ERP paradigm is prevalent in the environment and infused into macro actors with their prior training and education, and socialization dominated the ERP design activity. General ERP paradigm suggests that ERP is an application that covers the whole organization, uses the same database to provide timely and correct information to business users. Furthermore, ERP software applications are prepared packages that suggest certain ways of working and claims that these are best practices. Hence, for superior performance, organizations should make minimal or no modifications in their ERP system.

Table 9-7 ERP paradigms disposing ERP design in case studies

ALPHA	• Designers considered ERP as an application repository and the two ERP applications were designed to operate in tight integration. • Designers considered ERP as a business backbone covering the whole company. All MERCURY modules were purchased, although there were no plans of implementing all of them. • Designers considered as a data repository, asset BOMs and locations defined with great detail in MINERVA. • Almost no modification was planned for MERCURY in design. Minimal modification was planned for MINERVA.
BETA	• Differences in understanding ERP among macro-actors created a major controversy on whether or not an ERP system should fit a company and select NEPTUNE or not. • The general manager convinced that NEPTUNE could not be modified according to the requirements of BETA and would impose an "iron cage". • ERP design was made to perfectly fit the ERP solution to the current processes in BETA and PHAROS was selected.
KAPPA	• ERP was troublesome and should be avoided. Hence ERP was banned. • ERP was designed to cover all company operations to get the "best practices" through the ERP system. Minimal customization was aimed.
ZETA	• NEPTUNE process templates were "best-practice" models and ZETA should change to fit NEPTUNE. • NEPTUNE is the consolidated and central data repository that provides timely and correct data for the whole company.

In ALPHA, KAPPA and ZETA, this paradigm dominated the macro actors' decisions. This was also widely discussed in BETA as well. However in BETA, both the prior socialization of the general manager and the soft nature of PHAROS, ERP design followed a different paradigm. As an industrial engineer, BETA General Manager argued that "a successful company should keep its unique operations for competition" and "companies that operate with similar or same operations cannot compete with their core processes". Since BLIX promised to entirely modify PHAROS, its structural feature became infinitely soft and its disciplining nature became just a guideline for the ERP design (See Table 9-7).

9.1.2.2. Meso Level

Similar to the mechanism in macro level structures, meso level structures also dominate and discipline respective actors during ERP implementation. ERP Schemas were followed by the actors during implementation. However, since ERP design was to follow existing operations and fulfill users' requirements, respective ERP schemas provided a guideline for ERP implementation.

Table 9-8 ERP schemas disposing ERP implementation in case studies

ALPHA	• ERP Schemas were implemented with minimal changes and turnarounds devised to make the software act differently without making changes in the software itself. • A software development company was hired for customization according to requirements described by the implementation team using MINERVA as a framework
BETA	• BETA interpreted PHAROS as a perfectly soft technology and changed totally. PHAROS only provided a disciplinary framework for developers to work on. • PHAROS disciplined BETA accountants and instead of simple book keeping, financial results of user transactions were first recorded in a temporary book and finalized later by accountants. • Decision on total modification of PHAROS to perfectly match the current practices significantly decreased the disciplining effect.
KAPPA	• ERP schemas dominated the implementation team, hence they did not have much time to analyze the current processes in detail and decide on the implementation. • During implementation, KAPPA participants claimed numerous critical requirements and hence extensive customization was required. • Designers backed the requirements however were slow in providing approvals that they required at the beginning.
ZETA	• The process designs prepared according to NEPTUNE business process templates were strictly followed. • Product definitions and software integrations were performed according to the ERP implementation schemas.

Furthermore, similar to BETA case, in later stages of ALPHA – MINERVA case, ERP implementation continued with user's orders and micro agents assumed the roles of a meso actor. This decision also made MINERVA nearly a perfectly soft technology and made the schemas to provide a guideline rather than a dominating or disciplining factor for the meso level actors (See Table 9-8).

9.1.2.3. Micro Level

Similar to Macro and Meso levels, observations at Micro level also follows the RDT model arguments. In all of the cases, ERP logics are imposed on users and users had to adapt to the changes in their use required by the new logic. Such changes were minimal for BETA and relatively low for later stages of ALPHA-MINVERVA, compared to ALPHA-MERCURY.

Table 9-9 ERP logics disposing ERP use in case studies

ALPHA	• Users had no option but use the system as implemented, since it wasn't easy to change MERCURY. • Integrity of a financial transaction could be damaged, if users did not follow the described sequences of MERCURY use. • MINERVA users were devising their own routines of using the system with the guidance of peers and informal training. • MINERVA changes that wouldn't be harmful for another system component were readily accepted.
BETA	• Since ERP implementation was performed following the current processes exactly, it also matched with the existing logic of performing daily tasks before the system.
KAPPA	• At the beginning of use, ERP was working much slower than what was planned. • Centralization of operational control and reporting was achieved. • Many of the manual tasks were eliminated with the ERP use.
ZETA	• The amount of required change created resistance among employees, but they were forced by their managers to use and also report their change requests. • The implementation team later convinced request-owners to withdraw or delay their requests, claiming they were infeasible

In KAPPA, introduction of the ERP system caused significant technical problems and hence, the new logics became infinitely soft, since the users had to create their own ways of using the system, irrespective of what logics were designed and instructed, in order to decrease the impact of the technical problems. The dominance of the logics was most observable in ZETA, where the changes required compared to prior behaviors of users were highest. However, ZETA users were dominated by the new logic of ERP use. Similar to ZETA, also ALPHA-MERCURY users had to follow their new logics due to the nature of the performed operations (See Table 9-9).

9.1.3. Contextualization of ERP Concept

Following the arguments of Mouzelis (1989), the RDT model argues that actions of higher-level agents create the structural aspects for the lower level agency. More specifically, the RDT model posits that ERP Designers (macro actors) contextualized their ERP paradigms into ERP schemas (for meso actors) with force. Similar to Macro – Meso interface, a similar mechanism is expected at Meso – Micro interface. ERP implementers (meso actors) contextualize their ERP schemas into ERP logics with force.

9.1.3.1. Macro Level to Meso Level

Case study observations suggest that Macro actors in these organizations apply varying levels of force to form the structural properties for lower level agents and to contextualize their paradigm into schemas of meso level actors. For example, macro actors in all of the cases either rejected or strongly disfavored change requests of implementers and wanted the implementation to take place without any changes following schemas prepared. In KAPPA, application of force even went to the level of financially threatening the implementation team with not getting bonuses or application of fines. (See Table 9-10).

Table 9-10 Contextualization from macro level to meso level in case studies

ALPHA	• The ERP Steering Committee and the implementation team leaders rejected change requests in implementation. • ERP Steering Committee ordered the implementation team to immediately start implementation, without any modifications in implementation plans and designs.
BETA	• Despite the opposing views in the implementation team, top managers insisted on perfectly fitting PHAROS to the existing business practices without any changes.
KAPPA	• Top managers asked for a very quick implementation considering only necessary modifications and customizations, leading to very tight schedules. • Management rejected any arguments and warned them that in case of late delivery of the project, the implementation team may not receive the annual bonus payments or may be subject to contractual fines. • The schema of the implementation was to collect critical requirements, get their approval from the design team, prepare and rollout the implementation.
ZETA	• Initial designs were followed and minimal changes planned since each major change had to be explained and agreed with senior managers.

9.1.3.2. Meso Level to Micro Level

Similar to observations between Macro – Meso interface, agents apply force to contextualize their schemas into micro-level logics in case studies. Implementers applied force in the form of structured training programs, using a forcing-language that states using the system as compulsory and even relocating the resisting users in the organization. However, since the target of the ERP implementation in BETA was to match ERP system with the existing business processes, the changes remained minimal and application of force became unnecessary.

Just as macro-actors, in a way threatened the meso level actors in KAPPA, meso level actors in turn also used a threatening language with micro level actors to force them to follow the logic presented. In ALPHA-Minerva case, since the users did not have a prior logic for using a system for those specific tasks, the implementation team did not need to apply force to micro actors to make them follow designed logics. However, for ALPHA-Mercury, many of the users resisted in their use of the system, but the implementation team forced the users to accept the system and even relocated a power-user, who was the champion of the resistance (See Table 9-11).

Table 9-11 Contextualization from macro to meso level in case studies

ALPHA	• The users had been instructed on what MERCURY and MINERVA were and how they should be used. • Resisting users were forced to use and the person who resisted the system most was relocated to a different position. • MERCURY change took place on the New Year day without a concurrent-run, to force the users to use the system as described. • MINERVA users did not have an option to act otherwise because this was their first system and they were not experienced.
BETA	• The perfect match approach decreased the level of force required to create the ERP logics at the user side.
KAPPA	• A very comprehensive training program for all of the users all over the country. • Detailed use-case scenarios and workshop type screen trainings to make users accept the logic of using ERP. • The users were asked to enter the data online and not to create any batch data entry which would "have serious side effects for everybody".
ZETA	• Despite initial resistance, users were forced to accept that the NEPTUNE ERP system automatically creating accounting records for some transactions. • Operational data should be handled with care on the screens like financial data, changing the logic of ERP use.

9.1.4. Conflicts in ERP Systems

The RDT model posits that when an agent drifts significantly in its actions, it creates a conflict with actions at the next level(s) and exerts influence it to reconcile this conflicted. Observations in these case studies supports these arguments and described in detail below.

9.1.4.1. Micro Level to Meso Level

Between Micro and Meso level relationships, the RDT model argues that when ERP use drifts significantly, it conflicts with ERP implementation and exerts influence, trying to change it. For example, drifts in use influenced implementation team to cancel some of the modules and functionalities in the ALPHA-MERCURY, ALPHA-MINERVA and ZETA cases and integration of new functionalities into design in the ALPHA-MINERVA, BETA and KAPPA cases. The interaction between MERCURY and MINERVA was especially interesting because, differences in using MERCURY and MINERVA, influenced the implementation team to move some of the functions from MERCURY to MINERVA, where users were more accepting towards the system. Whereas, changes in the KAPPA case were mostly due to drastic problems in the introduction of the system, where the system performance were unacceptably slow and users could not even use the system due to technical problems. Hence, users had to invent new methods of doing their tasks and using the system, which later influenced the implementation team to incorporate these new methods into ERP implementation (See Table 9-12).

Table 9-12 Conflict in ERP systems at the micro level in case studies

ALPHA	• MERCURY inventory module was canceled due to problems in use and site related parts of the inventory functionality were transferred to a new module in MINERVA. • Other site-related issues such as recording site-related invoices for accounting that were actually planned on MERCURY were transferred to MINERVA. • Due to modifications in use, preventive maintenance and resource planning modules of MINERVA could not be implemented. • Modifications in MINERVA use motivated some non-users to influence the implementation team to integrate their work with MINERVA.
BETA	• Users' demand for ad-hoc reporting influenced implementation to create data export interfaces for further analysis on Access and Excel • Common use of transaction correction functionality influenced the implementation team to create a transaction freezing function to limit corrections.
KAPPA	• Speed of using ERP was not acceptable and implementation was changed to increase performance. • Users had to perform everything manually with user-invented methods, the schemas of implementation changed and some of the legacy systems resumed. • User groups who devised new uses with Microsoft Excel influenced the implementation team to integrate their Excel files with MERCURY.
ZETA	• A more complex workflow was demanded by management for purchasing and sales orders which required acquiring a new NEPTUNE module.

9.1.4.2. Meso Level to Macro Level

Between Meso and Macro level relationships, the RDT model argues that when ERP implementation drifts significantly, it conflicts with ERP design and exerts influence, trying to change it. In the ALPHA-MERCURY case, since a number of MERCURY modules could not be implemented, the scope of the ERP design was later revised and those unimplemented modules were taken out of the implementation. Designs were also updated in the ALPHA-MINERVA case, which had been targeting to follow the assets precisely. However, since the data in MINERVA was not up-to-date and the level of detail in recording the assets decreased, the MINERVA design was changed to accommodate these differences. Whereas, the BETA, design was prepared with the aim of integrating all the systems with PHAROS; however, implementation changes also revised the design at the macro level and integration with the shop-floor systems was postponed. The design changes were most drastic with ZETA, where implementation problems influenced the design to have a very fundamental change and ERP features that were acknowledged as "the most important" previously, were cancelled (See Table 9-13).

Table 9-13 Conflict in ERP systems at the meso level in case studies

ALPHA	• Many of the MERCURY modules had not been implemented and the design was updated. Some functions were taken out of the scope to other applications. • The data in MINERVA was not up-to-date and the level of detail decreased. This influenced updating the ERP design and arranging annual asset counts. • MINERVA evolved into a site management platform, some of the fundamental financial functions about sites were transferred from MERCURY to MINERVA.
BETA	• Data quality problems influenced the design and postponed integration of production systems, which were used for cross-checking.
ZETA	• In order to avoid re-occurrence of significant implementation problems, some design items have changed significantly. • Following of the production and WIP inventory cancelled, shop-floor started to be considered as a black-box.

9.1.5. Modification of the ERP System

The RDT model accommodates that ERP related actions were not entirely determined by the respective structural elements, but actors had a capacity to make different interpretations of the same structural element of the technology and act accordingly. Hence, actions of different actors may differ significantly under same structural conditions. However, the RDT model posits that when drifts in action cannot be accommodated within the multiple interpretations of structural elements, the actions try to influence their structural element. If the respective structural element cannot be modified, then drifts in action would eventually recede and be abandoned. Following sections summarize observations at different levels in the case studies.

9.1.5.1. Micro Level

Following the arguments of RDT, in case studies, I observed that when drifts in ERP use cannot be accommodated within multiple interpretations of ERP logics, ERP use modifies ERP logics through influence. However, I also observed that such drifts eventually recede and are abandoned if they couldn't influence ERP logics.

For example, ALPHA-MERCURY users stopped using some of the side functionalities that were heavily emphasized during design and implementation. Despite the prior emphasis in using those functions, since this did not overwhelm ERP logics, it did not created any problems and users were allowed to change their pattern of using the system. Whereas for ALPHA-MINERVA during the evolution of MINERVA into a site-management platform, users started storing site-specific documents by creating valueless assets on sites to be able to store documents on each site. However, this was beyond the logic of using the system. However, adding some of the documents into MINERVA later became a legitimate way, so the way of using the system and the logic was influenced by the use. Whereas, for BETA, the aim of matching the ERP system to the existing user practice made users was very influential on the logics of using the system. Whenever the logic of ERP use proposed by PHAROS required a change in current practice, users' influence made PHAROS change to its own structure instead, even in regard to financial transactions. For KAPPA, ERP introduction problems made users devise their own logics to be able to use the system. However, when the technical problems had been resolved, some of these invented logics became incorporated into the system and the others recede and were abandoned later (See Table 9-14).

Table 9-14 Modification of the ERP system at the micro level in case studies

ALPHA	• MERCURY users stopped using some of the side functionalities that were heavily emphasized during design and implementation. • Since this change did not threaten any critical function of MERCURY it was allowed within the existing logic of system use. • MINERVA users modified their logic of using the system shortly after they became familiar with the system and started storing some site-specific documents by creating valueless assets on locations. • Later this modified use created performance problems, reviewed by the implementation experts and partially prevented but some documents allowed making the modified logics a legitimate use of MINERVA. • Although, users were asked to immediately enter any changes in asset information into MINERVA, they started making batch data entries, which the implementation team later accepted. However, users became neglectful later and ALPHA started making annual asset counts all over Turkey to update data.
BETA	• When the logic of ERP use proposed by PHAROS required a change in current practice, users' influence made PHAROS change its own structure instead. • The privilege of being able to delete a transaction was only for the "power users" in accounting. However, the users started sharing their passwords. • Later the logic drifted so that "any accountant could delete a transaction" and everybody in accounting had the rights to "correct" a transaction.
KAPPA	• Since the sales locations had to complete reconciliation of their daily accounts, the users had to work very long hours every workday for 3 months. • Due to the slowness of the system, users had to devise new ways of using PHAROS. Unlike the instructions, they had to make batch data entries for 3 months. • Some of the user groups devised Microsoft Excel workbooks for recording manual transactions and data entry methods to MERCURY.
ZETA	• Workers started entering shop-floor data late. ZETA could not solve the problem and accepted to have shop-floor data 1-2 shifts later.

9.1.5.2. Meso Level

We also observed that when drifts in ERP implementation cannot be accommodated within multiple interpretations of ERP schemas, ERP implementation modifies the ERP schemas through influence at the meso level. However, I also observed that such drifts eventually recede and abandoned if they couldn't influence the ERP schemas.

Table 9-15 Modification of the ERP system at the meso level in case studies

ALPHA	• MERCURY implementation had reduced to a functional minimum. Schemas were modified and reduced into what was accepted and therefore "completed". • MINERVA schemas were turned into a "site management platform" and they asked other site management related teams to get integrated with MINERVA. • Some power-users were given the authority to make changes on the user interfaces of MINERVA and non-proper uses of screens and fields were accepted. • A user division was given the authority to continue with the MINERVA implementation, as they deemed appropriate, with the help of a contractor.
BETA	• Purchasing practice fundamentally changed PHAROS, altering the ERP implementation towards integration with the central ERP system. • Since product coding schemes did not match, BETA altered its ERP schemas and appended the product coding of the central purchasing unit to PHAROS.
KAPPA	• ERP schemas were updated to acknowledge Excel workbook integrations as legitimate forms of data entry.
ZETA	• In order to update NEPTUNE data with actual situation, shop-floor counts planned first as weekly then almost daily. • Later, temporary adjustments on BOMS according to the short term production plan attempted in implementation. • However, NEPTUNE schemas could not be modified to enable this and hence the implementation change had to be abandoned. • The order-production-confirmation schema was cancelled and planned level of inventories increased.

For example, in ALPHA-MERCURY, due to changes in implementation, schemas were modified to be able to "complete" the project. Whereas, for ALPHA-MINERVA, the ERP system became the "site management platform" and the related schemas were updated to integrate other site-related information sources in MINERVA. In BETA, changes in the implementation of purchasing operations, changed PHAROS schemas and a central ERP system was integrated with PHAROS, updating all the coding schemes for product description for purchasing. In KAPPA, implementation changes made to accommodate users influence also influenced ERP schemas and the plans were updated to reflect changes in the implementation. The situation were also similar in ZETA, where the meso-level changes in implementation to avoid further problems also reflected in the ERP schemas and the plans were updated accordingly (See Table 9-15).

9.1.5.3.Macro Level

At the macro level, I also observed that when drifts in ERP design cannot be accommodated within multiple interpretations of ERP paradigms, ERP design tries to influence ERP paradigms at the organizational level. However, I also observed that such drifts eventually recede and are abandoned if they couldn't influence ERP paradigms carried by macro actors. For example, in ALPHA, revision in the ERP schemas and contradictory problems created doubts and questions about the ERP systems among top managers. Site Management, which was once denied as an ERP task by some of the top managers, later became a part of the ERP functionality.

Table 9-16 Modification of the ERP system at the macro level in case studies

ALPHA	• Revision in the ERP schemas and contradictory problems created doubts and questions about the ERP systems especially among top managers. • Site Management, which was once denied as an ERP task by some of the top managers, was later accounted for as part of the ERP functionality. • ALPHA revised its perception of ERP from being "enterprise-wide" and "tightly-integrated" to be more receptive to the current state of the system.
BETA	• Macro actors reached nearly a consensus that companies should use an advanced ERP package like NEPTUNE for a larger footprint and better functionality,. • They also reached a consensus that ERP should not fit to the organization perfectly, but rather it can establish best practices and force organization to change.
ZETA	• NEPTUNE was initially considered as operational software. However, changes in its design influenced macro-actors understanding of ERP. • Initially the focus had been on operational integrity and consolidation of legacy systems for the whole company. • Lately, the focus was on reporting integrity and central data repository for related functions.

ALPHA revised its perception of ERP from being "enterprise-wide" and "tightly-integrated" to be more receptive to the current state of the system. Whereas for BETA, after the general manager's leaving the company for a higher-level position in the business group, remaining macro actors reached nearly a consensus that "all the companies should use an advanced ERP package like NEPTUNE" and "ERP should not fit to the organization perfectly, but rather it represents a medium of best practices that needs to change the organization". On the other hand, in ZETA, while ERP was initially considered as operational software, the changes in design also influenced macro-actors understanding of ERP and they started using ERP technology not for operations but for reporting and consolidation. Although such changes did not modify the general ERP paradigm, the ERP paradigm infused in macro-actors became modified at the organizational level (See Table 9-16).

9.1.6. Contradictions and Reconfiguration in ERP Concept

In addition to the above processes of technology adaptation, the RDT model also considers the structural interaction between structures at multiple levels in an organization. The RDT model argues that different structural components at different levels may dominate each other and later regulate each other with domination. According to RDT, a lower level structural component may also dominate a higher-level structural component if it dominates the other forms of structuring of the technology.

9.1.6.1. Micro and Meso Levels

According to the RDT model, when ERP logics and ERP schemas contradict, they regulate each other with domination. For example, in the ALPHA-MINERVA case, the "Site Management Platform" term dominated the other forms of describing the MINERVA system at higher levels. Implementers followed the logic of the users and the schemas were updated to reflect the new way of understanding the MINERVA system as a site management platform, rather than an asset management platform. Whereas, for MERCURY, the logic of not using some of the functions and modules, later dominated the schemas and the schemas were updated without questioning the lower level logics of using MERCURY. Similarly, PHAROS implementation schemas, which were aiming to consolidate all user workbooks and user developed small databases for reporting, were dominated by the users' logic of using MERCURY as the data source for their reports and data export / import mechanisms were planned in schemas to enable users to continue using their workbooks for reporting (See Table 9-17).

Table 9-17 Contradictions between micro and meso levels in case studies

ALPHA	• Some MERCURY users did not use certain functionalities. Therefore some of the modules were postponed and cancelled. • Due to problems in use, some of the MERCURY functions such as workflow and human resources were moved to the best-of-breed independent applications. • MINERVA was an "asset management platform" but with alternations in its use, it is now perceived by the implementation team as a "site management tool". • Users' logic of "all information in one screen" dominated MINERVA schemas, changing the application implementation accordingly.
BETA	• Exporting data for ad-hoc reporting dominated schemas to modify initial plans on eliminating stand alone databases and complex worksheets.
ZETA	• Complex flows deemed as necessary and initiated on paper forms, which were used before NEPTUNE... • The implementation team had taken those processes out of NEPTUNE and manual integration was required. • Later, some other flows also followed the scheme and switched to paper, just like their original flow before NEPTUNE.

9.1.6.2. Meso and Macro Levels

In addition to the Micro-Meso interface, the RDT model also considers the conflicts between the Meso and Macro levels. According to the RDT model, when ERP schemas and ERP paradigms contradict, they regulate each other with domination. For example, in the ALPHA case, ERP paradigms later dominated ERP schemas of MERCURY and MINERVA when the steering committee ordered an audit of the system. According the results of the audit, ERP schemas were partially updated and the adaptation restarted. While this adaptation continued, macro actors in ALPHA also ordered a more comprehensive audit of the system from APOLLO Consulting which would reassure dominance of ERP paradigms available in the institutional environment. Whereas, BETA, with the technical and political forces coming from structural environment, ERP Schemas for new purchasing dominated the existing ERP paradigm in BETA and the purchasing functions were taken out of the ERP system, dominating the pre-existing ERP paradigm in the organization. On the other hand, in the ZETA case, ERP paradigm of being a central system replacing legacy systems was significantly modified making it a central reporting medium, rather than an operational system (See Table 9-18).

Table 9-18 Contradictions between meso and macro levels in cases

ALPHA	• MERCURY related issues that contradict with ERP schemas were taken to the ERP Steering Committee, which ensured the domination of ERP paradigms. • ERP Steering Committee arranged an audit team and later ordered the cancellation of some of the changes schemas. Hence ERP paradigms dominated. • ALPHA ordered an ERP post-implementation audit from APOLLO, covering MERCURY and MINERVA to reassure domination of ERP paradigms.
BETA	• Using two coding schemes concurrently for purchasing was in contradiction with the ERP paradigm but later meso level schemas dominated the previous paradigm.
ZETA	• The ERP paradigm of being a central system replacing legacy systems was significantly modified, due to the cancellation of order-production-confirmation schema making it a central reporting medium, rather than an operational system.

9.2. Recursive Dualism of Technology in Organizations

Recursive Dualism of the Technology Model is constructed while making use of Duality of Technology (Orlikowski, 1992), combination of structuration and institutionalization (Barley and Tolbert, 1997), and dualism of actors and structures at multiple levels (Archer 1995, Mouzelis 1995), it also describes the interrelations of actors and structures in relation to a set of power relations (Lawrence, Winn and Jennings, 2001). The RDT model combines these ideas and approaches and different forms of power processes are the linking concept of the duality and the dualism of technology adaptation.

According to the RDT model, a macro actor contextualizes the technology and creates the structural element for the meso actor (schema) by force. Through mediation of the force in schemas of technology, meso level actor gets disciplined or dominated depending on the durability of the schema depending on the hardness and softness of the technology. If the agency of meso level actors could be accommodated within the interpretive flexibility of schemas, the limits of action (implementation) would be structurally determined whereas, if meso-level actors' drift in implementation could not be accommodated within the multiple interpretations of schemas, the implementer would have to either influence macro-level actions (design) to change the force applied that contextualizes schemas for the meso actor or try to directly influence to change the schemas. However, while macro-level actors were applying power, meso-level actors may not influence the structural element since it would be the same as questioning the legitimacy of the force applied by higher level agents. On the other hand, when the intensity of the force decreases over time, the meso level actor would have more freedom to influence schemas. If meso level actors could find an opportunity to change schemas, then a structural contradiction between structural elements would start to appear.

Similar to above mechanism, a meso actor contextualize the technology and implement the structural elements for the micro actor (logic) by force. Through mediation of the force in logics of technology, micro level actors get disciplined or dominated, again depending on the durability of the logics depending on the hardness and softness of the technology. If the agency of micro level actors cannot be accommodated within the interpretive flexibility of logics, the limits of action (use) will be structurally determined. However, if the micro-level actors' drift in use cannot be accommodated within the multiple interpretations of logics, the user has to either influence meso-level actions (implementation) to change the force applied that contextualize logics for the micro actor or try to directly influence them to change the logics. Similar to macro-meso level interaction, questioning the legitimacy of the force applied by implementers, micro-level actors may not influence logics of technology use. However, as the intensity of the force decreases over time, micro level actors would have more opportunity to influence the logics. If micro level actors could find an opportunity to change logics, then a structural contradiction between structural elements would start to appear.

When these mechanisms work concurrently, different types of phenomena become observable. For instance, if a meso-level actor is not effectively dominated or disciplined by schemas, then the force (s)he applies to contextualize logics may or may not be based on schemas prepared. The Meso-level actor may take the opportunity to dominate higher level structures and actors by trying to contextualize logics based on his/her target. Such pragmatic moves might increase structural contradictions and agency conflicts or can help meso level actor to influence schemas with the domination of contextualized logics to further dominate paradigms and influence design. When an actor is in this paradigmatic dualism (Mouzelis, 1995), institutionalization is not complete and legitimation of technology has not been achieved. A technology cannot be institutionalized, while the structuration continues and the actors are in paradigmatic dualism.

Although in all of the cases above that there are similar tendencies at work throughout the technology adaptation process, what emerges in each case is contingent upon the situationality of actors and structures. The RDT model is able to provide an explanation to both dramatic and emergent changes due to technology adaptation in organizations. The RDT model does not view the non-linear dynamics of change only as taking place in turbulent environments, nor does it reject the notion of planning. However, it recognizes that there are often critical moments that enable actors to influence change. According to the RDT model, processes of change occur within organizations that operate in relatively stable environments as well as those operating in dynamic turbulent business contexts at different paces and with different procedural dynamics.

According to the RDT model, power and politics have a central role in understanding stability and change during technology adaptation. The RDT model considers both the contextual political forces in the immediate environment and the internal political mechanisms employed during technology adaptation. In this sense, it can also be criticized by privileging the political perspective while investigating technological adaptation in organizations.

9.2.1. Meta-Theoretical Discussion of the RDT Model

The RDT model posits that technologies are predecessors of human action. It is "realistic" in the sense that it presupposes the pre-existence of structure in understanding the agency and model tends to be explanatory rather than descriptive. It considers technology adaptation as a process of structuration and institutionalization, which is nondeterministic in nature. Unlike the extant models of structuration and institutionalization (e.g., Orlikowski 1992; Kling and Iacono 1989; Hanseth and Monteiro 1997), the RDT model asserts that the process of technology adaptation is rather unpredictable and dynamic rather than pre-determined and stationary. A new technology put in use will have both designed and emergent characteristics. Therefore, changes due to technology adaptation rarely satisfy the prior intentions of those who initiate the adaptation and may not be controlled precisely.

The RDT model offers an understanding of technology as a social institution that is "inter-subjective" (Fay, 1996) rather than purely "subjective" or "objective". It is epistemologically interpretive and to some extent critical. Being interpretive assumes that "people create and associate their own subjective and inter-subjective meanings as they interact with the world around them" (Orlikowski and Baroudi 1991, p. 5) and being "critical" aims "to critique the status quo, through the exposure of what are believed to be deep-seated, structural contradictions within social systems ..." (p. 5-6). Furthermore, consideration of power mechanisms opens a door to investigate not only structures of significance and legitimization but also domination, during technology adaptation in organizations.

The RDT model is "institutional" in that it opposes purely individualistic approaches to the technology phenomenon. According to the RDT model, organizations, individuals, and technologies are situated within institutional contexts and hence technology design, implementation, and use need to be studied and understood within their respective institutional contexts. Furthermore, according to the RDT model, technologies, like social institutions, should be understood in terms of both their material and virtual dimensions. As an institution, a technology is simultaneously local and global, and simultaneously pervasive and idiosyncratic. Thus, the paradoxical findings from different cases of technology deployment are quite understandable.

The ontological basis of the model is that agents and structures are hierarchically located and variable. Therefore, the RDT model is a "multi-level" model since it integrates the local and the global and aims its analysis of social reality and technology phenomenon. Then, the interplay between technology related structures and agencies becomes much more complex and dynamic than what extant approaches suggest. Technology and human action may enable and constrain each other differently having different capacities and mechanisms of power.

The RDT model is "dual" in the sense that it assumes the duality of structures and actors using the concept of "recursive dualism". "The duality of technology" (Orlikowski, 1992) that depicts technology as macro structures and humans or organizations as micro agencies which cannot provide an accurate understanding of the technology phenomena. The model incorporates both the notions of dualism and duality. This acknowledges a temporal division between structural preconditions and the moment of agency (Archer 1995). Structural aspects and human action are conceived as two different entities and studied separately for analytical and conceptual purposes.

9.3. Contributions of the Study

This study attempts to develop a comprehensive model of technology adaptation in organizations to enrich the accumulated knowledge in technology, especially in Operations Management (OM) related technologies such as Enterprise Resource Planning (ERP), Total Quality Management (TQM), Just-In-Time Manufacturing (JIT) and Knowledge Management Systems (KMS) from an Organization Studies (OS) perspective.

The study also provides critiques of extant approaches and offers insights into how such technologies unfold in organizations. Although organizations began to adapt ERP systems (ERPs) in the 1980s (Hayman 2000), academic interest in them has just gained momentum and there is relatively little research on packaged large-scale information systems such as ERP systems (e.g., Robey et al. 2002; Markus 2000). Moreover, most current ERP studies are positivist and descriptive; there is only one interpretive study and one critical study up until now. Dong et al (2002) claim that while previous studies have provided interesting findings, only limited aspects of ERP systems have been explored, and our understanding of enterprise systems is still preliminary. Based on the literature review the authors note, "what we have studied focuses primarily on the iceberg above the sea, ignoring what is going on under the water"(p.862). It should be noted that there are several other studies of large-scale organizational technologies, which tend to focus on how large-scale information systems get developed. However, unlike this study, they pay little attention to how these technologies get adapted in organizations. This is a serious issue since the deployment of ERP technologies has long been a major trend in almost every industry. This dissertation attempts to respond to the need of theoretical frameworks that will help better understand the adaptation of large-scale packaged software technologies in organizations, such as ERP technology. It does so analytically through the RDT model and empirically through studying five different cases to investigate the major aspects of technology design, implementation and use in organizations, based on RDT.

The RDT model attempts to contribute to organization studies by combining structuration and institutionalization to expand the understanding of social institutions and the process of construction and maintenance of a social institution at the organizational level. As Scott (2001) noted, early theorists tended to assume that institutional frameworks were monolithic and unified and that institutional forces external to the organizational systems affected and determined the outcomes. The RDT model recognizes the existence of diverse institutions and different agencies, and stresses the non-determinant, interactive nature of the institutional processes.

Finally, the dissertation also contributes to theory building in organization studies and operations management by presenting the RDT model as a meta-theoretical framework, which considers both local, contingent aspects of socio-technical change, and the dynamics in the broader social structures simultaneously and its empirical investigation. The model itself can also be used as a guide to design research and data collection and further as a meta-framework for data analysis.

9.3.1. Practical Contributions

The increasing number of failure of organizational change initiatives with technology adaptation has drawn attention to the inadequacy of a one-best-way approach of technology and organizational development consultants. In seeking to develop a comprehensive understanding of how change unfolds, the RDT model, also provides insight into the process of continuity and change in technology adaptation. Although the RDT model enables us to point out some practical aspects of technology adaptation, it is far less prescriptive than what is available in the practitioner-oriented literature (e.g. Kotter, 1996).

The RDT model offers some practical implications for living with technology adaptation and change in organizations. Recognizing the potential contradictions in structure and the conflicts in action realms may help organizational actors to understand points of tension and triggers of change regarding to technology in organizations. However, projecting how dynamics of technology adaptation may interact to produce change and transform organizations and prepare exact plans of organizational change may not be feasible. Following March and Olsen (1989), the RDT model supports that technology design “rarely satisfies the prior intentions of those who initiate it, change cannot be controlled precisely” (March and Olsen 1989, p. 65-66). Hence, a set of managerial prescriptions on how to successfully implement change cannot be developed and offered for the actors’ use at this time. Considering the complex nature of relationships during technology adaptation a viable strategy for actors at different levels would be to have a contextual grasp of the modes of technology adaptation and be sensitive to contradictions in structure and conflicts in action while navigating within the dynamics of technology and organization. Therefore, in offering conclusions for practice, the study is in agreement with what Palmer and Dunford (2002, p. 245) describes as a “navigating approach”:

> In the navigating approach to change, control is still seen as the heart of management actions, although a variety of factors external to managers mean that while they may achieve some intended change others will also occur over which they have little control. Outcomes are often emergent rather than planned and result from a variety of convergent influences, competing interests, and processes.

However, in this way, the RDT model does not deny the importance of planning for change, but rather it points out that technology adaptation and organizational change are unpredictable and therefore that there will be a need to accommodate and adapt to the unexpected. The unforeseen turns and revisions are part of managing the technology adaptation in an organization.

9.4. Limitations of the Study

The main limitations of this study stems from the research method and design used. First of all, it should be noted that no research strategy is superior to all others (Benbasat et al 1987), and case study research is no exception. Case research was considered the most appropriate research strategy for this dissertation. However, the research strategy itself has some limitations that should be acknowledged (Yin 2002).

One limitation is with two generic weaknesses of theory building from cases pointed out by (Eisenhardt 1989). Eisenhardt noted, "a hallmark of a good theory is parsimony, but given the typically staggering volume of rich data, there is a temptation to a build theory which tries to capture everything. The result can be theories which is very rich in detail, but lacks the simplicity of the overall perspective" (p. 547). Another weakness is that building theory from cases may result in a narrow and idiosyncratic theory. "Case study theory building is a bottom-up approach such that the specifics of the data produce the generalizations of the theory. The risks are that the theory describes a very idiosyncratic phenomenon or that the theorist is unable to raise the level of generality of the theory" (p. 547). In my opinion these weaknesses come from "the process of inducing theory using case studies" (Eisenhardt 1989, p. 532). The author's understanding of "theory building" from case studies follows a grounded theory (Strauss and Corbin) tradition, which utilizes induction (or "theory from data"). These weaknesses have been addressed in the dissertation by taking an analytical generalization perspective where the model developed analytically from prior research and it is further evaluated with empirical data collected during multiple, comparative case studies performed with the "replication logic".

Our attempt to study technology and change in an organization over time and in context guided us to the development of certain theoretical concepts and link theoretical concerns with methodological considerations. Since I aimed to see the empirical reality regarding to technology adaptation in organizations in several case sites, being limited as to time and resource availability of a dissertation, I selected a cross-sectional research design that covers multiple sites, where history of technology adaptation was collected with multiple retrospective interviews.

The retrospective nature of interviews may lead to post-hoc rationalizations of changes described during the interviews. In order to handle this problem, the research openly searches for and uncovers the different views and experiences of individuals and groups at all levels within the organizations. The intention is to provide a framework for exploring the contemporary experience of change in the workplace for a range of different employees. Furthermore, the accounts and experiences described during interviews are also attempted from a cross-checking using secondary sources and archival data.

However, in order to critically examine the process of technology adaptation in organizations, longitudinal field studies can be further performed in the future to capture the dynamic processes of adaptation as they happen, together with people's experiences regarding to the past, interpretations of the current and expectations about the future, as a continuous process.

9.5. Directions for Further Studies

In this study the RDT model has been applied to technology adaptation in organizations. The model can also be applied to investigate other technology-related organizational phenomena such as technology innovation where it can offer new insights. It can also be applied to other large-scale software technologies such as KMS, CRM, which are cited with high failure rates, like ERP. It has been already recognized that knowledge management systems have failed mainly because of technologists' lack of understanding of the situated work practices and human elements of the systems' user communities (Schultze and Boland, 2000). KMS often clash with corporate culture, pay insufficient attention to people management practice (Swan, Newell and Robertson 1999), organizational politics and other organizational issues (Alavi and Leidner, 2001). The RDT model posits that KMS should be understood as a technology to be institutionalized that have both virtual and material elements. Several authors (e.g., Bowker 1997; Schultze and Leidner 2002; Brown and Duguid, 2000; Boland and Tenkasi, 1995; Schultz and Boland, 2000; Swan et al. 1999; Alavi and Leidner, 2001; Braa and Rolland, 2000) in KM research have already recognized the virtual elements of KMS are equally important as the actual elements of such systems.

Technologies such as ERP, CRM and KMS are all based on pre-packaged software solutions that are to be implemented. The RDT model can also be used to explain other software technologies such as rapid-prototyping or end-user development. This may lead to interesting results and reveal more about the validity and explanatory power of RDT. However, the RDT model is not limited with software-based technologies only. Using the RDT model to explain other technologies, like hardware or knowledgeware, may be of interest for further research.

Throughout the dissertation, I emphasized the dual nature of institution and institutionalization. Unlike early theories, the RDT model offers a dynamic view of institutions and institutionalization in regard to both stability and change. It is my understanding that the development and implementation of a technology contains two opposing forces. This aspect needs further development in a theoretical framework. A potential basis of this theoretical framework is dialectical theory (Van de Ven and Poole 1995). However, unlike extant understanding of dialectical theory as a theory of "change", the dialectic of two opposing forces in the development and implementation of technology seems to be the source of stability also. To my knowledge, this aspect of a dialectical process has not been the subject of much research.

In this study, I conceptualized technologies as social institutions. This re-conceptualization of technology can offer an alternative theoretical framework for analyzing technology failures. There have been two prevailing approaches to technology failure; one focuses on the material dimension of an information system and the other on its virtual dimension. The first tends to explain technology failure as failure of "system integration" (Lockwood 1964) or failure in functional performance (Offe, 1996) while the other as a failure of "social integration" or failure in socialization and preference formation. Both approaches are dichotomous and do not provide an adequate answer to technology failures. The RDT model suggests that both virtual and material dimensions should be considered in the analysis of technology failure. Then, technology failure can be more accurately explained through both social and system integration.

Finally, the constructs in the RDT model should be further defined and operationalized in a survey instrument that would enable a more precise data collection. This would enable devising further propositions and testing them statistically to strengthen and/or revise the model. Development of constructs in the RDT model will also enable us to utilize alternative research methodologies, like organizational modeling and agent-based simulations in the future.

9.6. Conclusion

This dissertation explored the prior understanding on technology adaptation in organizations and proposes an alternative theoretical conceptualization called the Recursive Dualism of Technology (RDT). Causal theoretical propositions are postulated for further empirical use without adopting a view of structural determinism or omnipotence of agency over social structures. The RDT model can be used empirically as a guide to design research, perform data collection, and analysis to study technology adaptation in organizations.

The RDT model underscores the dual nature of technology as an objective reality and a socially constructed product, without conflating the structural (objective) and agency based (subjective) sides of technology into the same whole. The RDT model allows researchers to understand technology as enacted by human agency as well as institutionalized in the social structure and relates technological implementations with their immediate wider context over time and space. Structuration is understood as a set of dynamic relationships embedded historically and contextually into the action realm whereas institutionalization is another set of dynamic relationships embedded into the structural realm. The structural changes may originate from each realm, propagating the other since both realms are recursively implicated, and considered as dynamic and dialectical (Orlikowski 1992, Seo & Creed, 2002). However, the RDT model follows the criticism put forward by Archer (1982, 1989, and 1995) and presupposes the pre-existence of structure before agency.

While the main component and relationship in this model can be considered as relatively stable, their range, content, and relative power will vary over time during technology adaptation. Unlike linear causal models, this model assumes a dynamic and highly non-linear nature due to feedback relationships between action and structure realms of technology, supporting or undermining each other's effects. Technology in an organization is considered as both stable and changing, both local and global. Therefore the RDT model is capable of explaining both emergent and discontinuous changes in the process of technology adaptation, making it a comprehensive account of technology adaptation in organizations.

It is impossible to conceive of an approach that is suitable for all types of technology and organizational relationships of all types of situations for different types of organizations. Some approaches may be too narrow in applicability while others may be too general. Some may be complementary to each other while others are clearly incompatible. The RDT model also does not claim completeness and capability of explaining all types of technology related issues in organizations. Although the model is inevitably limited by the authors' beliefs and interests, I submit that it overcomes some of the fundamental theoretical problems that are inherited in some of the prior perspectives on technology and organizations, and opens up new research venues for further empirical research, and provides ideas on living with technology adaptation in organizations.

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APPENDIX A. QUESTIONS FOR ELEMENTS OF THE RDT MODEL FOR ERP ADAPTATION

CONTEXTUAL FORCES

Normative Forces about ERP	Coercive Forces about ERP	Mimetic Forces about
• What do your business partners expect from the ERP technology in your company? • What do your customers expect from the ERP technology in your company? • What do your competitors expect from the ERP technology in your company?	• What are your suppliers / customers' requirements for the ERP technology in your company? • What are your shareholders requirements for the ERP technology in your company? • What are the legal and regulatory requirements for the ERP technology in your company?	• What is your assessment on your competitors' ERP technology? • What is your assessment on other companies' ERP technology? • Which companies are considered as example sites of ERP technologies?

ORGANIZATIONAL FORCES

Social Forces about ERP	Political Forces about ERP	Technical Forces about ERP
• What do the employees expect from the ERP technology in your company? • How is the ERP technology in your company expected to influence daily work and work load? • How is your ERP technology expected to influence employee's roles and responsibilities and job descriptions?	• Which organizational units have been supporting the ERP technology in your company? Why? • Which organizational units resist the ERP technology in your company? Why? • How does the ERP technology in your company function for organizational control?	• How does the ERP technology in your company relate with the company performance? • How does the ERP technology in your company relate with the information systems infrastructure? • How does the ERP technology in your company relate with the managerial decision making?

MACRO LEVEL **ERP Paradigms**	MESO LEVEL **ERP Schemas**	MICRO LEVEL **ERP Logics**
• How do you assess the ERP design in your company? • What has been planned for the ERP design in your company? • What changes are expected in the ERP design, in your company?	• How do you assess the ERP implementation in your company? • What has been planned for the ERP implementation in your company? • What changes are expected in the ERP implementation, in your company?	• How do you assess the ERP use in your company? • What have been planned for the ERP use in your company? • What changes are expected in the ERP use, in your company?

Design ERP	**Implement ERP**	**Use ERP**
• How do you develop the ERP system design in your company? • Which software modules are included in the ERP system design? • Which business processes and functions are covered in the ERP system design? • What integrations have been designed for the ERP system? • What are your main tasks in the ERP design?	• How do you perform the implementation of the ERP system in your company? • Which software modules are implemented in the ERP system? • Which business processes and functions are covered in the ERP implementation? • What integrations have been implemented in the ERP system? • What are your main tasks in the ERP implementation?	• How do you use the ERP system in your company? • Which software modules are used in the ERP system? • Which business processes and functions are used in the ERP system? • What integrations have been used in the ERP system? • What are your main tasks in the ERP use?

MACRO LEVEL **Dispose ERP Design**	MESO LEVEL **Dispose ERP Implementation**	MICRO LEVEL **Dispose ERP Use**
• What are your references in your ERP design? • How does the ERP design relate to your understanding of the ERP system?	• What are your references in your ERP implementation? • How does the ERP implementation relate to your understanding of the ERP system?	• What are your references in your ERP use? • How does the ERP use relate to your understanding of the ERP system?
Modify ERP Paradigms	**Modify ERP Schemas**	**Modify ERP Logics**
• What alternatives did you have in designing ERP system? • How were your initial understanding and plans on the ERP design changed or confirmed later? • Can you identify any critical moments or incidents in the ERP design, which changed your understanding of the ERP system?	• What alternatives did you have while implementing ERP system? • How were your initial understanding and plans on the ERP implementation changed or confirmed later? • Can you identify any critical moments or incidents in the ERP implementation, which changed your understanding of the ERP system?	• What alternatives did you have while using the ERP system? • How were your initial understanding and plans on the ERP use changed or confirmed later? • Can you identify any critical moments or incidents in the ERP use, which changed your understanding of the ERP system?

MACRO – MESO INTERFACE	MESO – MICRO INTERFACE
Contextualize ERP schemas	**Contextualize ERP Logics**
• How do the schemas of ERP implementation relate to the prior ERP design? • How are the schemas of ERP implementation aligned with the prior ERP design?	• How do the logic of the ERP use relate to the prior ERP implementation? • How is the logic of the ERP use aligned with the prior ERP implementation?
Conflict ERP design	**Conflict ERP Implementation**
• How was the ERP design followed and changed in the ERP implementation? • What are the main challenges in the ERP implementation that conflict with the ERP design? • How have the conflicting issues between the ERP design and the ERP implementation been resolved?	• How has the ERP implementation followed and changed in the ERP use? • What are the main challenges in the ERP use that conflict with the ERP implementation? • How have the conflicting issues between the ERP implementation and the ERP use been resolved?
Contradict ERP paradigm	**Contradict ERP schemas**
• What were the main contradictions between the understanding of the ERP technology during the ERP implementation and the ERP design? • How have these contradicting issues been resolved?	• What were the main contradictions between the understanding of the ERP technology during the ERP use and the ERP implementation? • How have these contradicting issues been resolved?

APPENDIX B. INTERVIEW PROTOCOLS

Interview Protocol – ERP Designers

Personal Details:

1. Age
2. Position & grade
3. Place of birth
4. Previous employment
5. How long have you been with the company?
6. When did your association with the ERP project start?

Reflecting back on the very first days of the ERP:

A. What external forces or motivators you had acknowledged for your company to have an ERP?

7. What had your business partners expected from you concerning the ERP technology in your company?
8. What had your customers expected from you concerning the ERP technology in your company?
9. What had your competitors expected from you concerning the ERP technology in your company?
10. What had your suppliers / customers' requirements been concerning the ERP technology in your company?
11. What had been your shareholders requirements concerning the ERP technology in your company?
12. What were the legal and regulatory requirements had been concerning the ERP technology in your company?
13. How did you view your competitors' ERP technology?
14. How did you consider any other companies' ERP technology?
15. Which companies had been considered as example sites of ERP technologies?

B. How did these factors change later and effected ERP in your company?

C. What internal forces or motivators had been acknowledged by your company to have an ERP?

16. What did the employees expected from the ERP technology in your company?
17. How did the ERP technology in your company expect to influence daily work and work load?

18. How did your ERP technology expect to influence employee’s roles and responsibilities and job descriptions?
19. Which organizational units had been supporting the ERP technology in your company? Why?
20. Which organizational units resisted the ERP technology in your company? Why?
21. How did the ERP technology in your company function for organizational control?
22. How did the ERP technology in your company relate with the company performance?
23. How did the ERP technology in your company relate with the information systems infrastructure?
24. How did the ERP technology in your company relate with the managerial decision making?

D. How did these factors change later and effected ERP in your company?

Remembering times before the ERP design had started:

25. How did you consider the ERP design in your company?
26. What hadbeen planned for the ERP design in your company?
27. What changes were expected about the ERP design, in your company?

Moving forward into the ERP design:

28. What references did you take into account for your ERP design?
29. How did the ERP design relate to your understanding of the ERP system?

Reflecting back the ERP design:

30. How did you perform the design of the ERP system in your company?
31. Which software modules were designed in the ERP system?
32. Which business processes and functions were covered in the ERP design?
33. Which integrations were designed in the ERP system?
34. What were your main tasks in the ERP design?

Moving forward to the ERP implementation:

35. Which schemas of the ERP implementation were related with the prior ERP design?
36. Which the schemas of the ERP implementation were aligned with the prior ERP design?

Considering later times in the ERP:

37. How did the ERP design follow and changed in the ERP implementation?
38. What were the main challenges in the ERP implementation that conflicted with the ERP design?
39. How the did the conflicting issues between the ERP design and the ERP implementation get resolved?
40. What were the main contradictions between the understanding of the ERP technology during the ERP implementation and the ERP design?
41. How were these contradicting issues resolved?

E. Is there any unfinished business? Which hurdles/issues remain?

F. What are your personal views on ERP concept and systems in general?

G. How do you feel about the ERP concept and system in your corporation?

Interview Protocol – ERP Implementers

Personal Details:

1. Age
2. Position & grade
3. Place of birth
4. Previous employment
5. How long have you been with the company?
6. When did your association with the ERP project start?

Reflecting back on the very first days of the ERP:

a. What external forces or motivators had you acknowledged for your company to have an ERP?

7. What had your business partners expected from you concerning the ERP technology in your company?
8. What had your customers expected from you concerning the ERP technology in your company?
9. What had your competitors expected from you concerning the ERP technology in your company?
10. What were your suppliers' / customers' requirements concerning the ERP technology in your company?
11. What were your shareholders requirements concerning the ERP technology in your company?
12. What were the legal and regulatory requirements concerning the ERP technology in your company?
13. How did you consider your competitors' ERP technology?
14. How did you consider any other companies' ERP technology?
15. Which companies had been considered as example sites of ERP technologies?

B. How did these factors change later and effected ERP in your company?

C. What internal forces or motivators had been acknowledged for your company to implement an ERP?

16. What did the employees expect from the ERP technology in your company?
17. How did the ERP technology in your company expect to influence daily work and work load?
18. How had your ERP technology been expected to influence employee's roles and

responsibilities and job descriptions?

19. Which organizational units had been supporting the ERP technology in your company? Why?
20. Which organizational units resisted the ERP technology in your company? Why?
21. How the ERP technology in your company had been functioned for organizational control?
22. How was the ERP technology in your company related with the company performance?
23. How did the ERP technology in your company relate with the information systems infrastructure?
24. How did the ERP technology in your company relate with the managerial decision making?

D. How did these factors change later and effected ERP in your company?

Remembering times before the ERP implementation had started:

25. Which schemas of the ERP implementation were related with the prior ERP design?
26. Which schemas of the ERP implementation were aligned with the prior ERP design?
27. How did you consider the ERP implementation in your company?
28. What was planned for the ERP implementation in your company?
29. What changes were expected about the ERP implementation, in your company?

Moving forward into the ERP implementation:

30. What references did you take into account for your ERP implementation?
31. How was the ERP implementation related to your understanding of the ERP system?

Reflecting back the ERP implementation:

32. How did you perform the implementation of the ERP system in your company?
33. Which software modules were implemented in the ERP system?
34. Which business processes and functions were covered in the ERP implementation?
35. Which integrations were implemented in the ERP system?
36. What was your main tasks in the ERP implementation?

Moving forward to the ERP implementation:

37. What alternatives did you have while implementing the ERP system?
38. How were your initial understandings and plans of the ERP implementation changed or confirmed later?
39. Could you identify any critical moments or incidents in the ERP implementation which changed your understanding of the ERP system?
40. How was the ERP design followed and changed in the ERP implementation?
41. What was the main challenges in the ERP implementation that conflicted with the ERP design?
42. How werebthe conflicting issues between the ERP design and the ERP implementation resolved?
43. What were the main contradictions between your understanding of the ERP technology during the ERP implementation and the ERP design?
44. How were these contradicting issues resolved?

Considering later times in the ERP:

45. How was the logic of the ERP use related with the prior ERP implementation?
46. How was the logic of the ERP use aligned with the prior ERP implementation?
47. How was the ERP implementation followed and changed in the ERP use?
48. What have been the main challenges in the ERP use that conflicted with the ERP implementation?
49. What were the conflicting issues between the ERP implementation and the ERP use resolved?
50. What have been the main contradictions between the understanding of the ERP technology during the ERP use and the ERP implementation?
51. How were these contradicting issues resolved?

E. Is there any unfinished business? What hurdles/issues remain?

F. What are your personal views on ERP concept and systems in general?

G. How do you feel about ERP concept and system in your corporation?

Interview Protocol – ERP Users

Personal Details:

1. Age
2. Position & grade
3. Place of birth
4. Previous employment
5. How long have you been with the company?
6. When did your association with the ERP project start?

Reflecting back on the very first days of the ERP:

a. What external forces or motivators do you think made your company want to have an ERP?

7. What did your business partners expect from you concerning the ERP technology in your company?
8. What did your customers expect from you concerning the ERP technology in your company?
9. What did your competitors expect from you concerning the ERP technology in your company?
10. What had been your suppliers' / customers' requirements concerning the ERP technology in your company?
11. What were your shareholders requirements concerning the ERP technology in your company?
12. What were the legal and regulatory requirements concerning the ERP technology in your company?
13. How did you considered your competitors' ERP technology?
14. How did you considered any other companies' ERP technology?
15. Which companies had been considered as example sites of ERP technologies?

B. How were these factors change later and effected ERP in your company?

D. What internal forces or motivators had been acknowledged for your company to have an ERP?

16. What were the employees expecting from the ERP technology in your company?
17. How did the ERP technology in your company expected to influence daily work and work load?

18. How did your ERP technology expect to influence employee’s roles and responsibilities and job descriptions?
19. Which organizational units had been supporting the ERP technology in your company? Why?
20. Which organizational units resisted the ERP technology in your company? Why?
21. How has the ERP technology in your company functioned for organizational control?
22. How did the ERP technology in your compan relate with the company performance?
23. How did the ERP technology in your company relate with the information systems infrastructure?
24. How did the ERP technology in your company relate with the managerial decision making?

D. How did these factors change later and effected ERP in your company?

Remembering times before the ERP use had started:

25. What were the logics of the ERP use related with the prior ERP implementation?
26. What were the logics of the ERP use aligned with the prior ERP implementation?
27. How did you consider the ERP use in your company?
28. What was the plan for the ERP use in your company?
29. What changes were implemented about the ERP use in your company??

Moving forward into the ERP use:

30. What references did you take into account for your ERP use?
31. How was the ERP use related to your understanding of the ERP system?

Reflecting the ERP use:

32. How did you use of the ERP system in your company?
33. Which software modules are used in the ERP system?
34. Which business processes and functions were used in the ERP system?
35. Which integrations have been used in the ERP system?
36. What are your main tasks in the ERP use?

Moving forward to the ERP use:

37. What alternatives did you have while using the ERP system?
38. What were your initial understanding and plans on the ERP use changed or confirmed later?

39. Can you identify any critical moments or incidents in the ERP use which changed your understanding of the ERP system?

Considering later times in the ERP use:

40. What was the logic of the ERP use as it related with the prior ERP implementation?
41. What was the logic of the ERP use in regard to how it aligned with the prior ERP implementation?
42. How did the ERP implementation followed and changed in the ERP use?
43. What were the main challenges in the ERP use that conflicted with the ERP implementation?
44. What were the conflicting issues between the ERP implementation and the ERP use resolved?
45. What are the main contradictions between the understanding of the ERP technology during the ERP use and the ERP implementation?
46. How were these contradicting issues resolved?

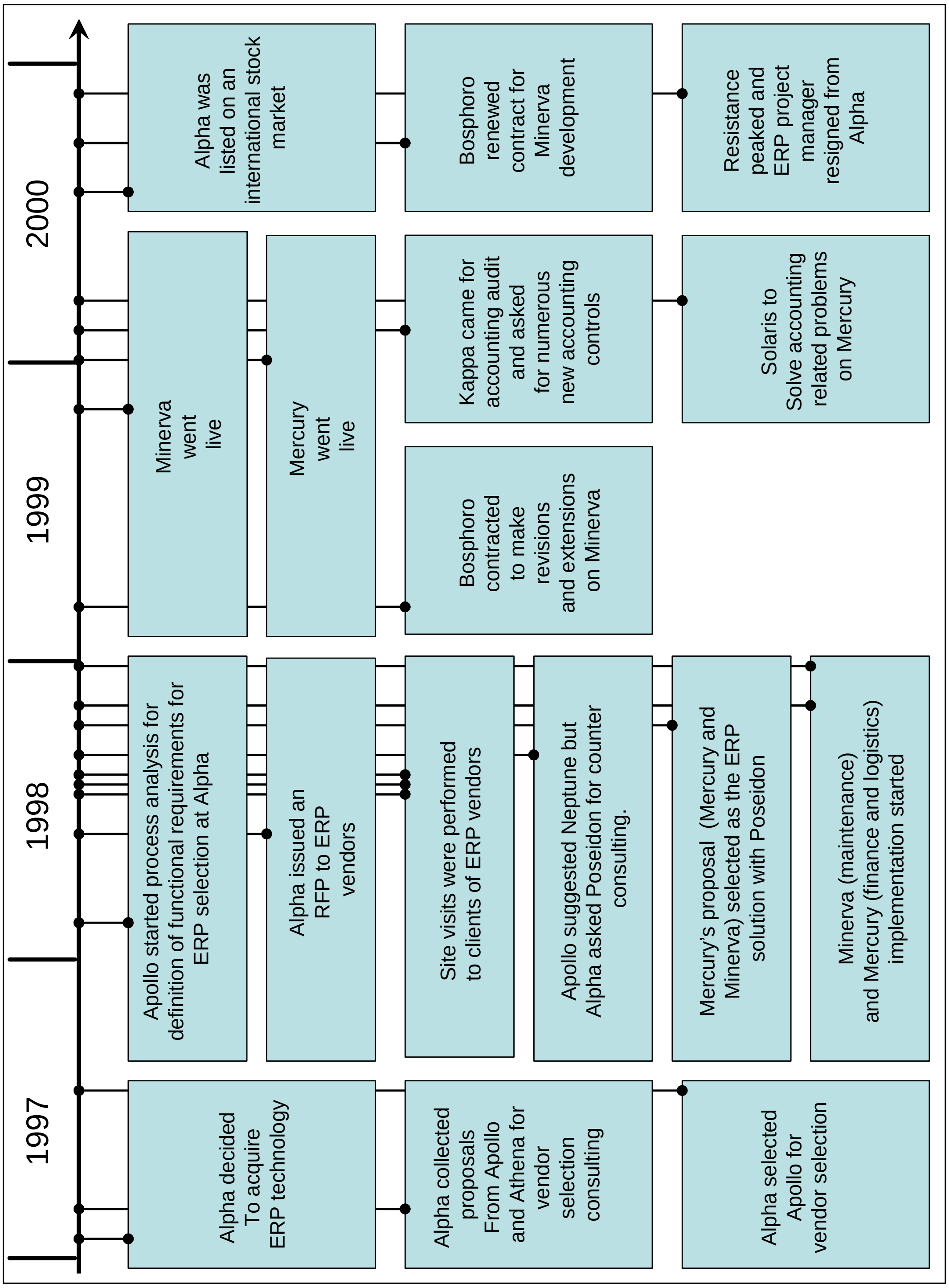
E. Is there any unfinished business? What hurdles/issues remain?

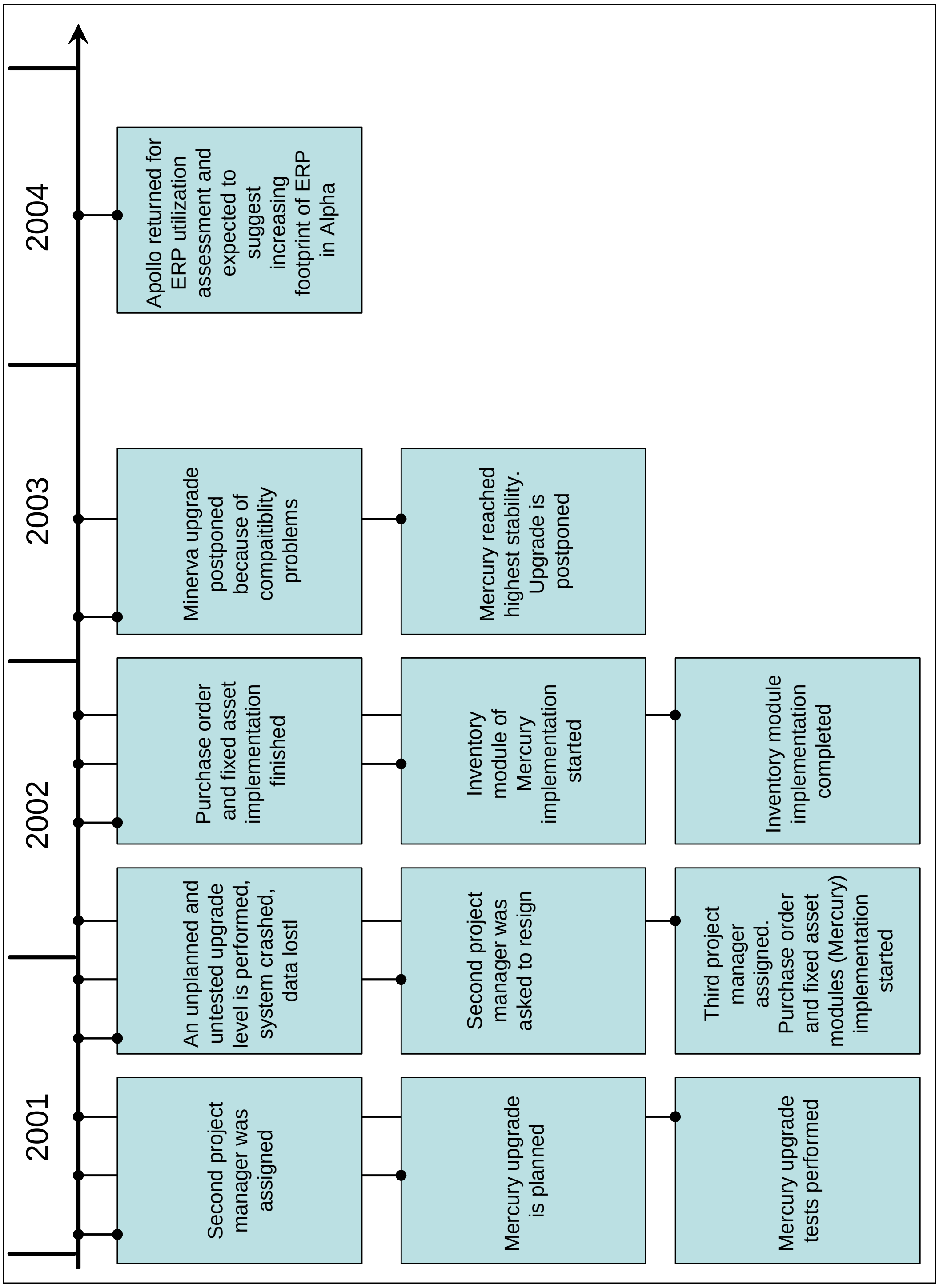
F. What are your personal views on ERP concept and systems in general?

G. How do you feel about ERP concept and system in your corporation?

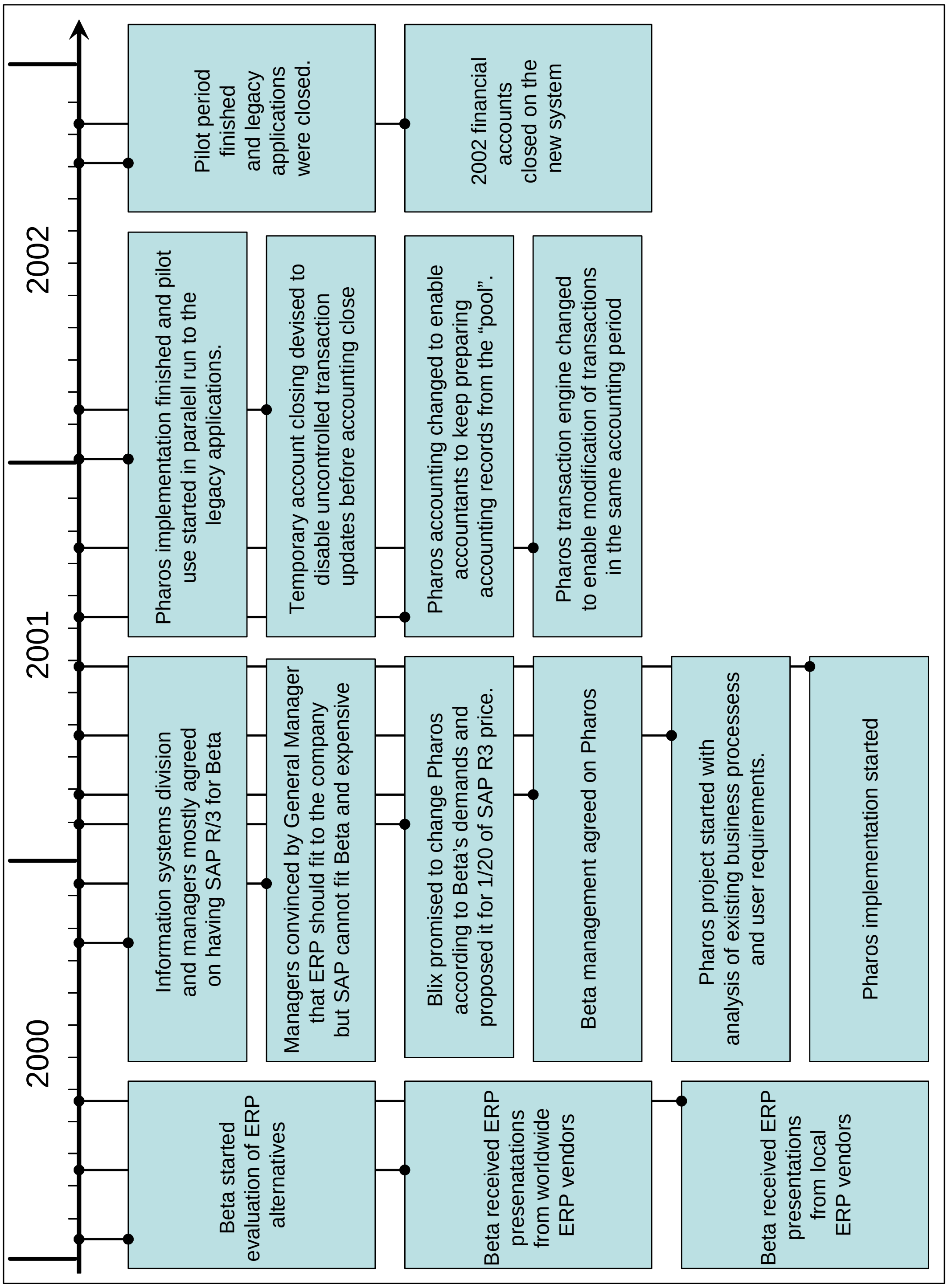
APPENDIX C. ERP ADAPTATION CHRONOLOGIES AND THE RDT MODEL SUMMARIES OF CASE STUDIES

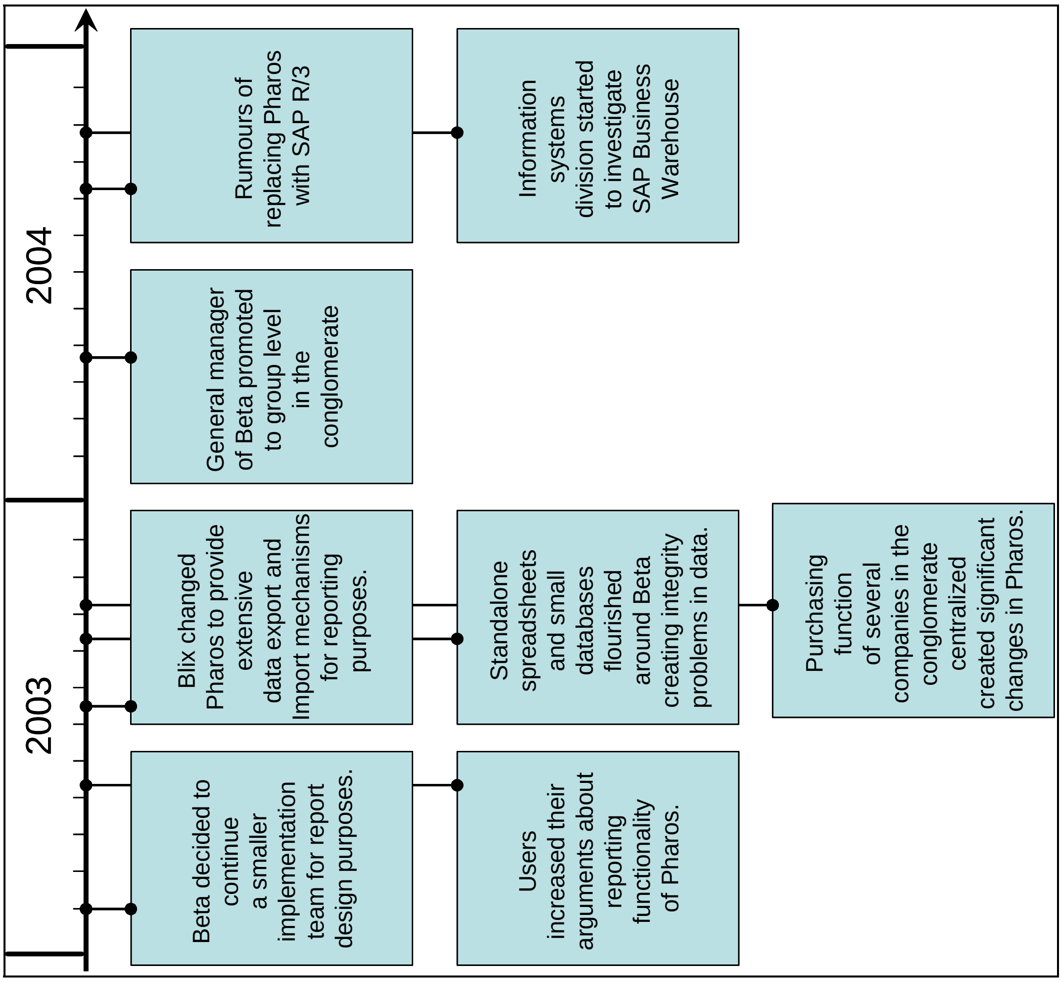
ALPHA CORPORATION

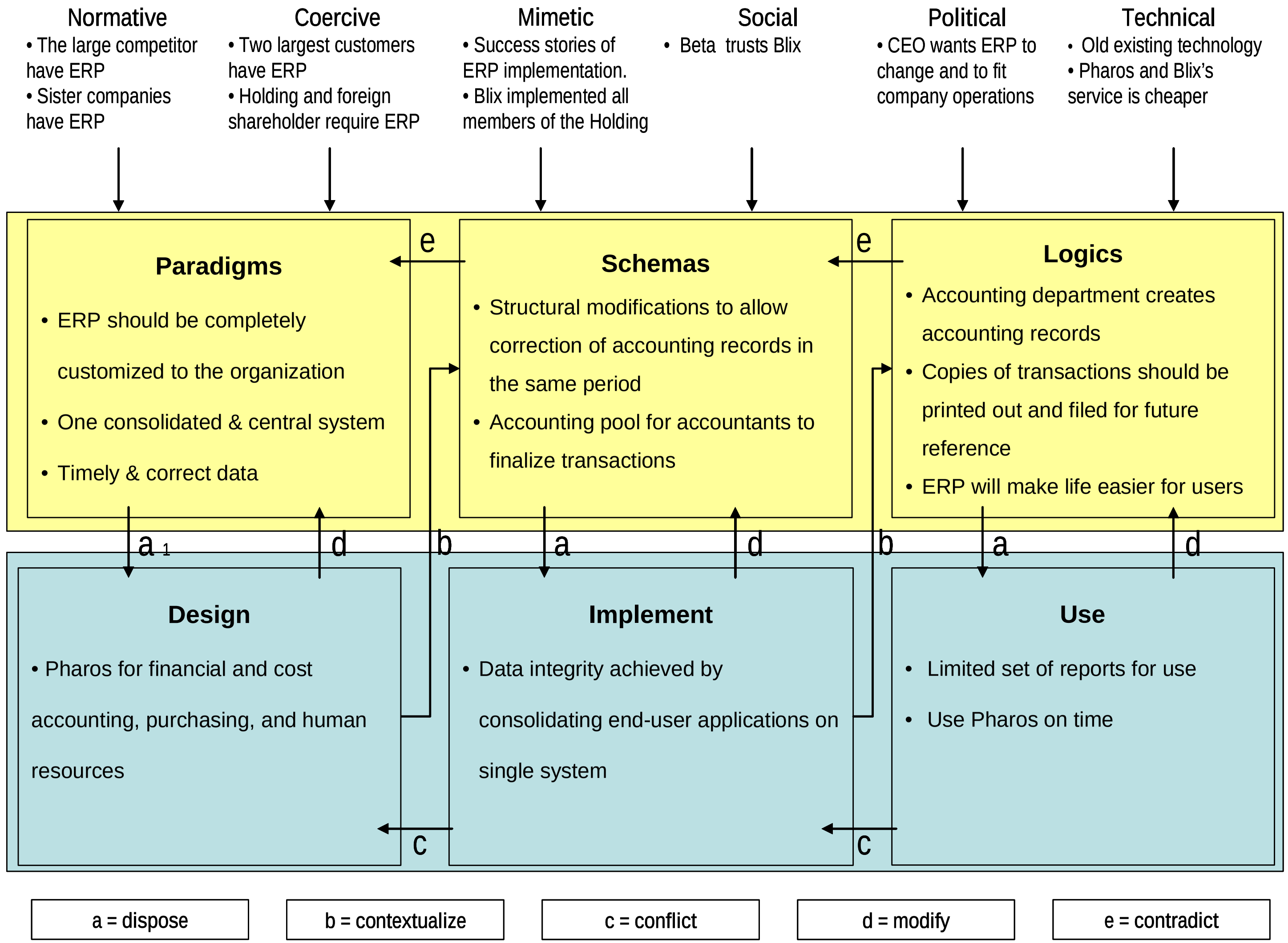

1997
1998
1999
2000
Alpha decided To acquire ERP technology
Alpha collected proposals From Apollo and Athena for vendor selection consulting
Alpha selected Apollo for vendor selection
Apollo started process analysis for definition of functional requirements for ERP selection at Alpha
Alpha issued an RFP to ERP vendors
Site visits were performed to clients of ERP vendors
Apollo suggested Neptune but Alpha asked Poseidon for counter consulting.
Mercury's proposal (Mercury and Minerva) selected as the ERP solution with Poseidon
Minerva (maintenance) and Mercury (finance and logistics) implementation started
Minerva went live
Mercury went live
Bosphoro contracted to make revisions and extensions on Minerva
Kappa came for accounting audit and asked for numerous new accounting controls
Solaris to Solve accounting related problems on Mercury
Alpha was listed on an international stock market
Bosphoro renewed contract for Minerva development
Resistance peaked and ERP project manager resigned from Alpha

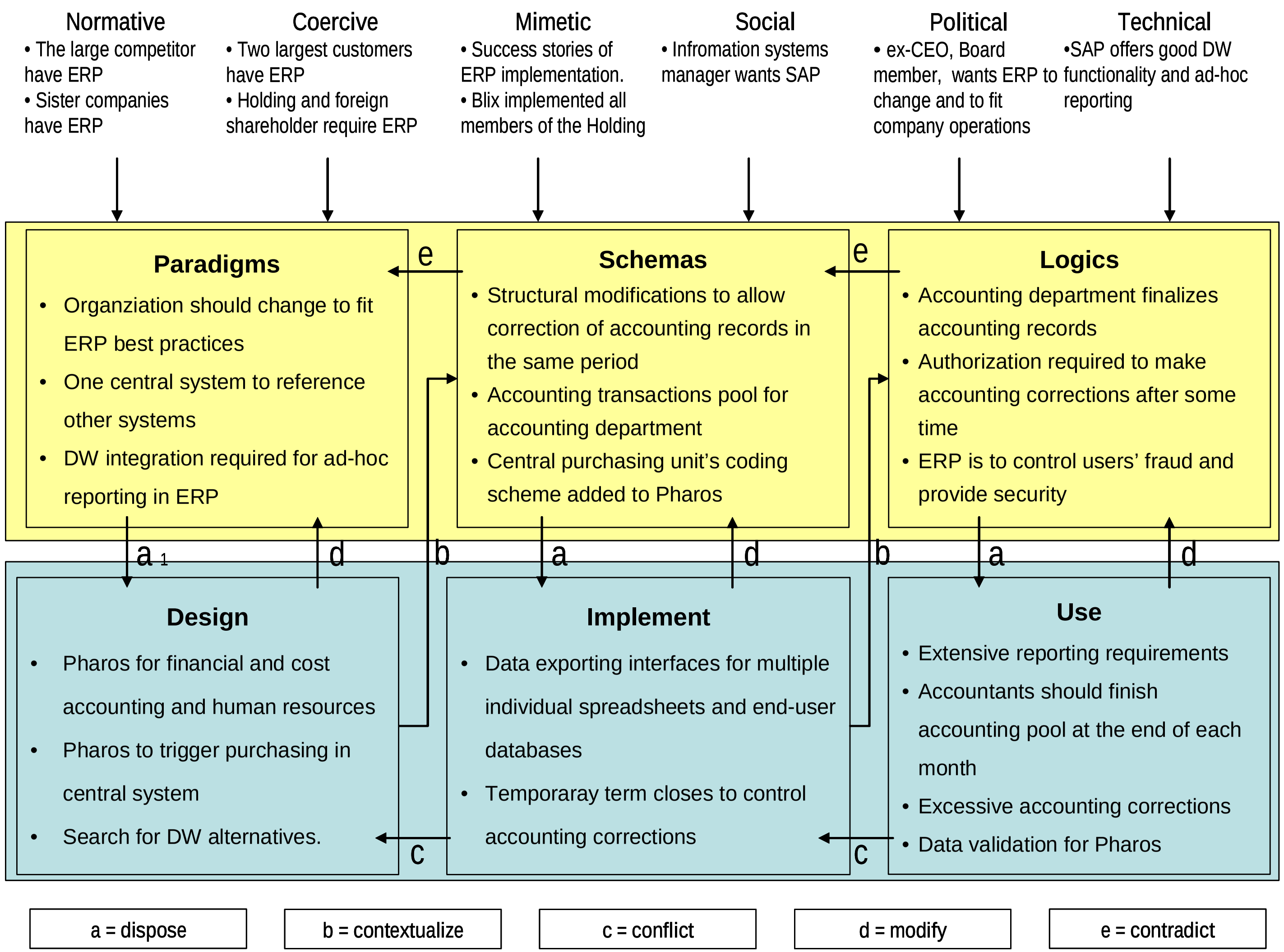

2001
2002
2003
2004
Second project manager was assigned
Mercury upgrade is planned
Mercury upgrade tests performed
An unplanned and untested upgrade level is performed, system crashed, data lostl
Second project manager was asked to resign
Third project manager assigned. Purchase order and fixed asset modules (Mercury) implementation started
Purchase order and fixed asset implementation finished
Inventory module of Mercury implementation started
Inventory module implementation completed
Minerva upgrade postponed because of compaitiblity problems
Mercury reached highest stability. Upgrade is postponed
Apollo returned for ERP utilization assessment and expected to suggest increasing footprint of ERP in Alpha

BETA CORPORATION

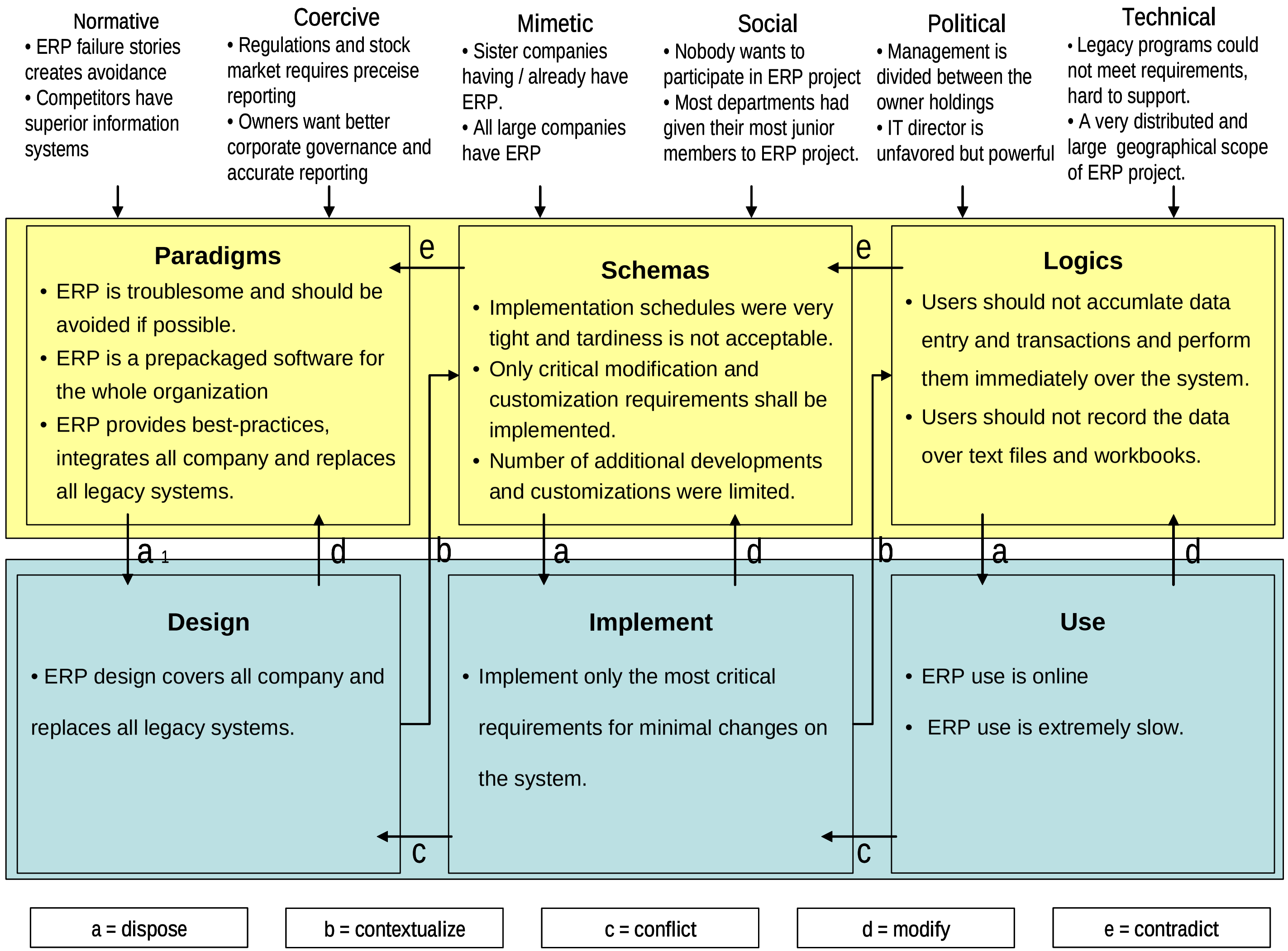

2000
2001
2002
Beta started evaluation of ERP alternatives
Beta received ERP presenatations from worldwide ERP vendors
Beta received ERP presentations from local ERP vendors
Information systems division and managers mostly agreed on having SAP R/3 for Beta
Managers convinced by General Manager that ERP should fit to the company but SAP cannot fit Beta and expensive
Blix promised to change Pharos according to Beta's demands and proposed it for 1/20 of SAP R3 price.
Beta management agreed on Pharos
Pharos project started with analysis of existing business processess and user requirements.
Pharos implementation started
Pharos implementation finished and pilot use started in paralell run to the legacy applications.
Temporary account closing devised to disable uncontrolled transaction updates before accounting close
Pharos accounting changed to enable accountants to keep preparing accounting records from the "pool".
Pharos transaction engine changed to enable modification of transactions in the same accounting period
Pilot period finished and legacy applications were closed.
2002 financial accounts closed on the new system

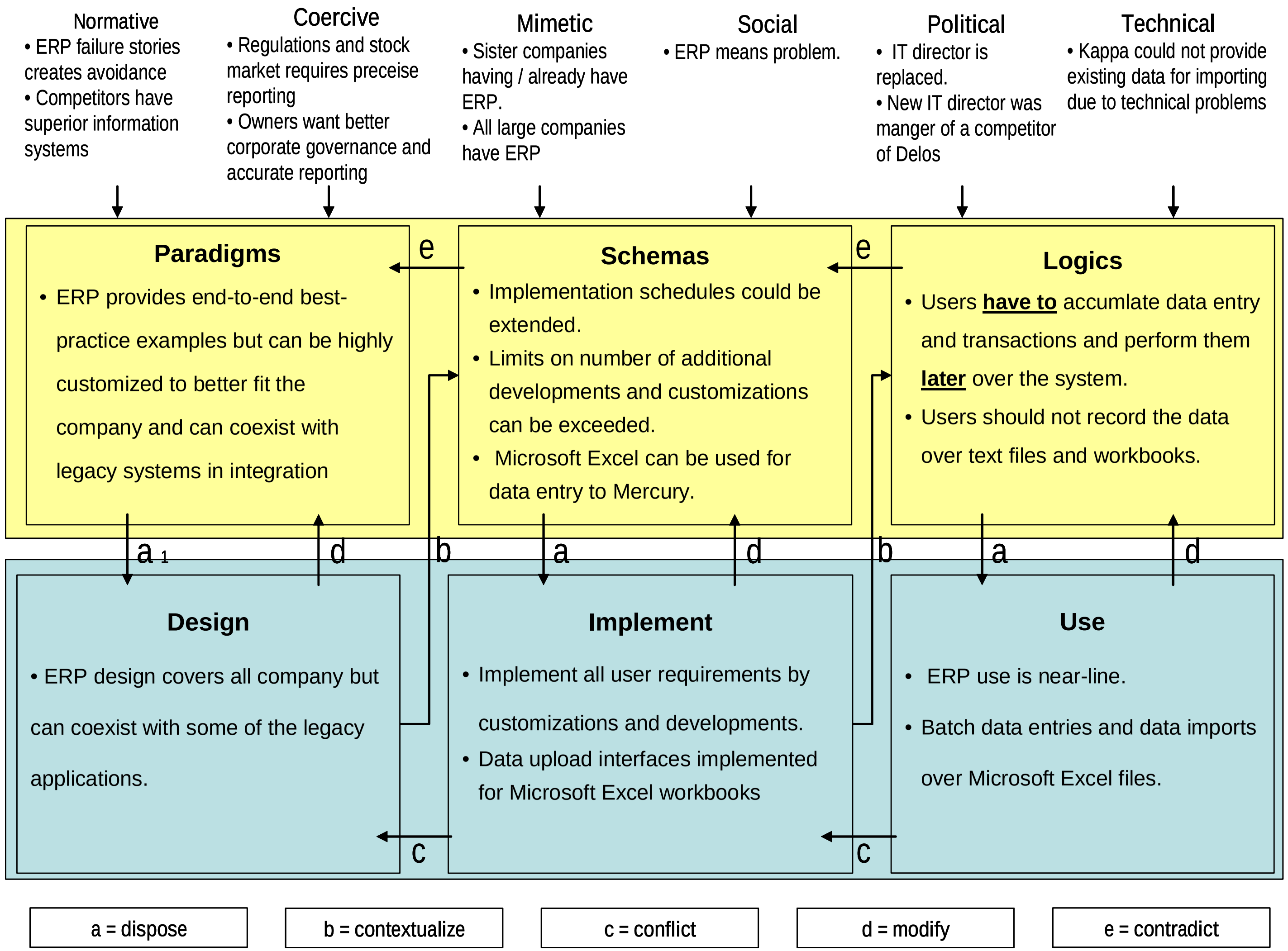

2003
2004
Beta decided to continue a smaller implementation team for report design purposes.
Users increased their arguments about reporting functionality of Pharos.
Blix changed Pharos to provide extensive data export and Import mechanisms for reporting purposes.
Standalone spreadsheets and small databases flourished around Beta creating integrity problems in data.
Purchasing function of several companies in the conglomerate centralized created significant changes in Pharos.
General manager of Beta promoted to group level in the conglomerate
Rumours of replacing Pharos with SAP R/3
Information systems division started to investigate SAP Business Warehouse


Normative
• The large competitor have ERP
• Sister companies have ERP
Coercive
• Two largest customers have ERP
• Holding and foreign shareholder require ERP
Mimetic
• Success stories of ERP implementation.
• Blix implemented all members of the Holding
Social
• Beta trusts Blix
Political
• CEO wants ERP to change and to fit company operations
Technical
• Old existing technology
• Pharos and Blix's service is cheaper
Paradigms
• ERP should be completely customized to the organization
• One consolidated & central system
• Timely & correct data
Schemas
• Structural modifications to allow correction of accounting records in the same period
• Accounting pool for accountants to finalize transactions
Logics
• Accounting department creates accounting records
• Copies of transactions should be printed out and filed for future reference
• ERP will make life easier for users
Design
• Pharos for financial and cost accounting, purchasing, and human resources
Implement
• Data integrity achieved by consolidating end-user applications on single system
Use
• Limited set of reports for use
• Use Pharos on time
a 1
a
b
c
d
e
a = dispose
b = contextualize
c = conflict
d = modify
e = contradict


Normative
• The large competitor have ERP
• Sister companies have ERP
Coercive
• Two largest customers have ERP
• Holding and foreign shareholder require ERP
Mimetic
• Success stories of ERP implementation.
• Blix implemented all members of the Holding
Social
• Infromation systems manager wants SAP
Political
• ex-CEO, Board member, wants ERP to change and to fit company operations
Technical
•SAP offers good DW functionality and ad-hoc reporting
Paradigms
• Organziation should change to fit ERP best practices
• One central system to reference other systems
• DW integration required for ad-hoc reporting in ERP
Schemas
• Structural modifications to allow correction of accounting records in the same period
• Accounting transactions pool for accounting department
• Central purchasing unit's coding scheme added to Pharos
Logics
• Accounting department finalizes accounting records
• Authorization required to make accounting corrections after some time
• ERP is to control users' fraud and provide security
e
e
a 1
d
b
a
d
b
a
d
Design
• Pharos for financial and cost accounting and human resources
• Pharos to trigger purchasing in central system
• Search for DW alternatives.
Implement
• Data exporting interfaces for multiple individual spreadsheets and end-user databases
• Temporaray term closes to control accounting corrections
Use
• Extensive reporting requirements
• Accountants should finish accounting pool at the end of each month
• Excessive accounting corrections
• Data validation for Pharos
c
c
a = dispose
b = contextualize
c = conflict
d = modify
e = contradict

KAPPA CORPORATION


Normative
• ERP failure stories creates avoidance
• Competitors have superior information systems
Coercive
• Regulations and stock market requires preceise reporting
• Owners want better corporate governance and accurate reporting
Mimetic
• Sister companies having / already have ERP.
• All large companies have ERP
Social
• Nobody wants to participate in ERP project
• Most departments had given their most junior members to ERP project.
Political
• Management is divided between the owner holdings
• IT director is unfavored but powerful
Technical
• Legacy programs could not meet requirements, hard to support.
• A very distributed and large geographical scope of ERP project.
Paradigms
• ERP is troublesome and should be avoided if possible.
• ERP is a prepackaged software for the whole organization
• ERP provides best-practices, integrates all company and replaces all legacy systems.
Schemas
• Implementation schedules were very tight and tardiness is not acceptable.
• Only critical modification and customization requirements shall be implemented.
• Number of additional developments and customizations were limited.
Logics
• Users should not accumlate data entry and transactions and perform them immediately over the system.
• Users should not record the data over text files and workbooks.
e
e
a 1
d
b
a
d
b
a
d
Design
• ERP design covers all company and replaces all legacy systems.
Implement
• Implement only the most critical requirements for minimal changes on the system.
Use
• ERP use is online
• ERP use is extremely slow.
c
c
a = dispose
b = contextualize
c = conflict
d = modify
e = contradict


Normative
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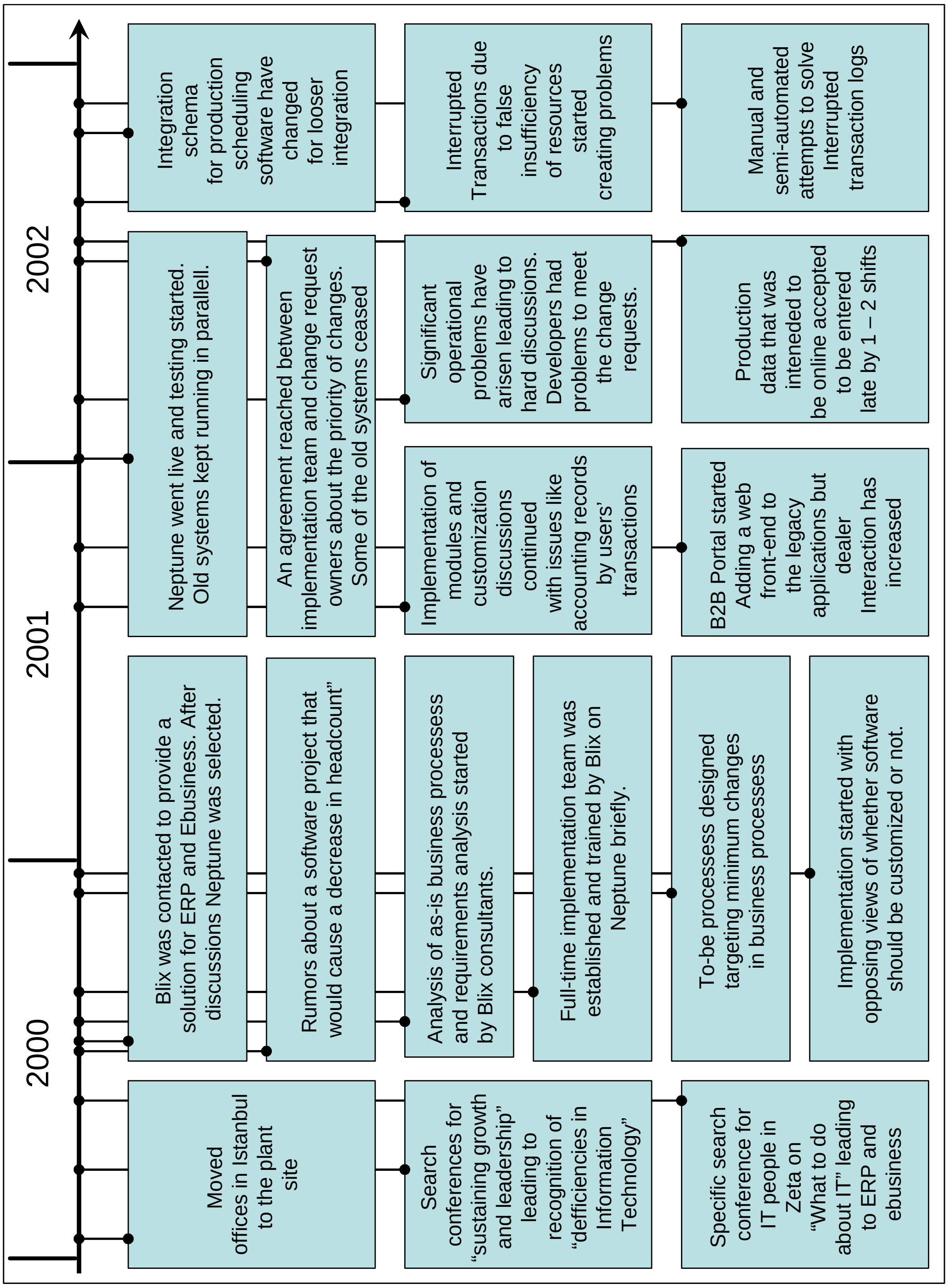
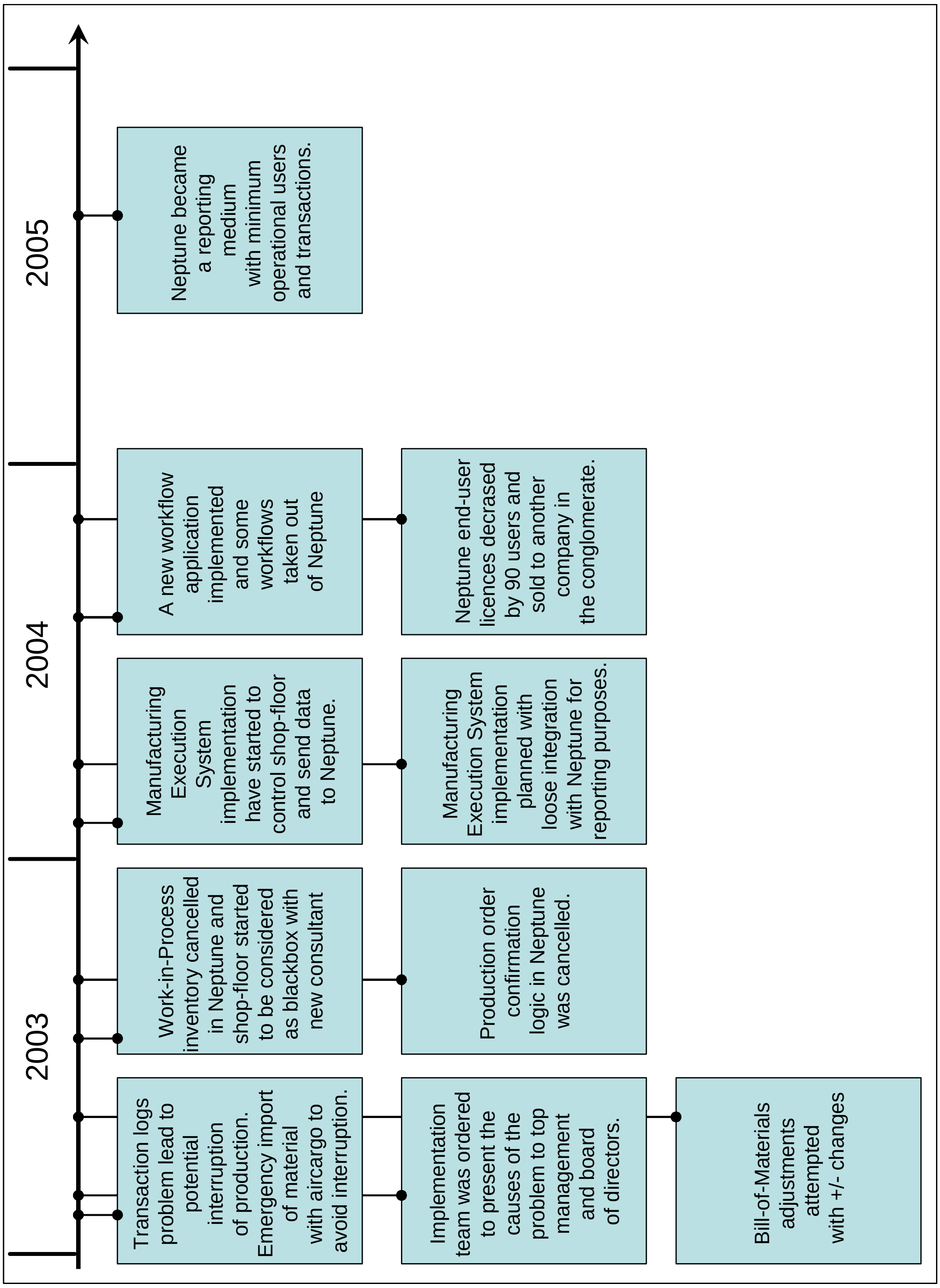
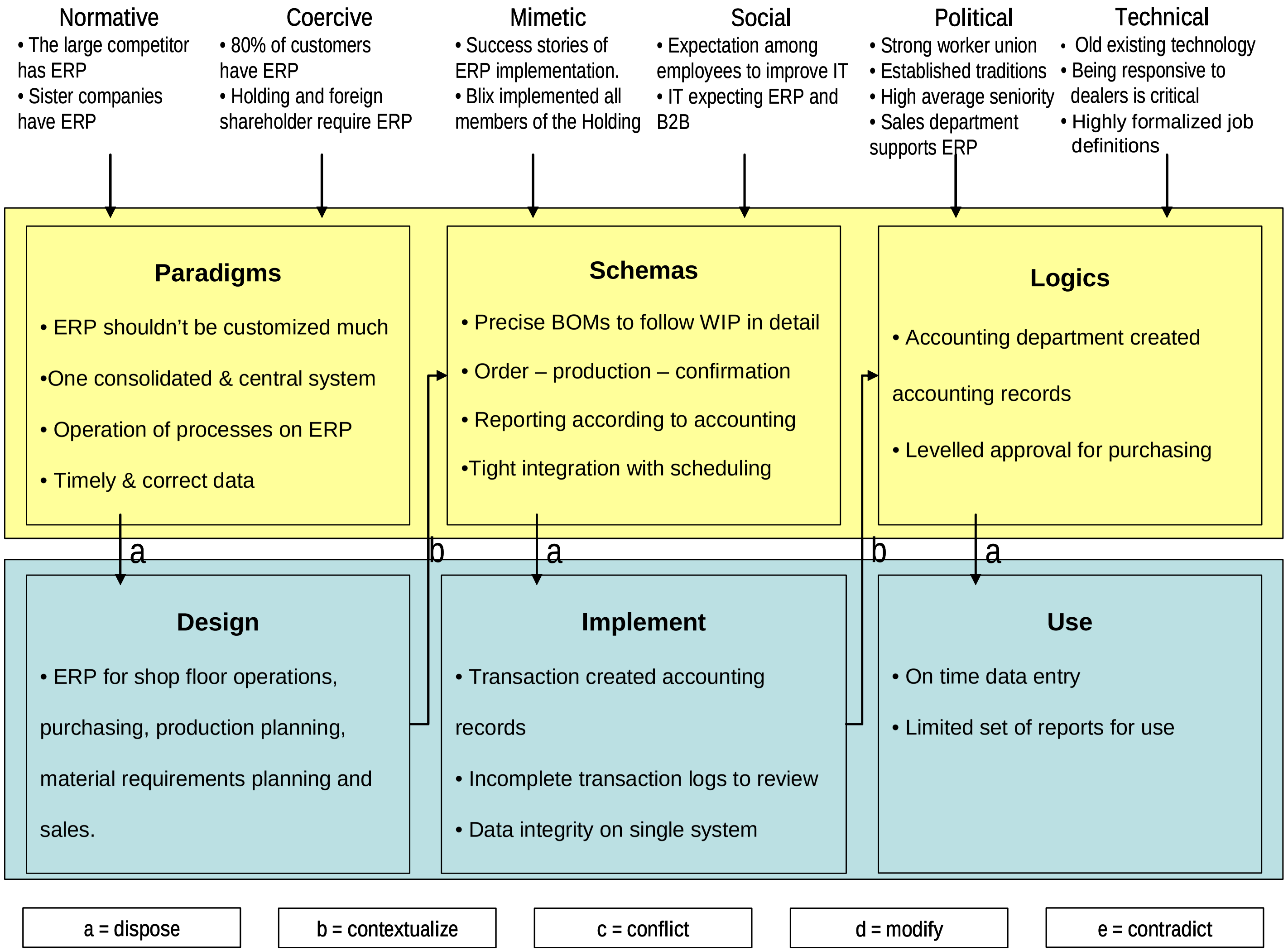
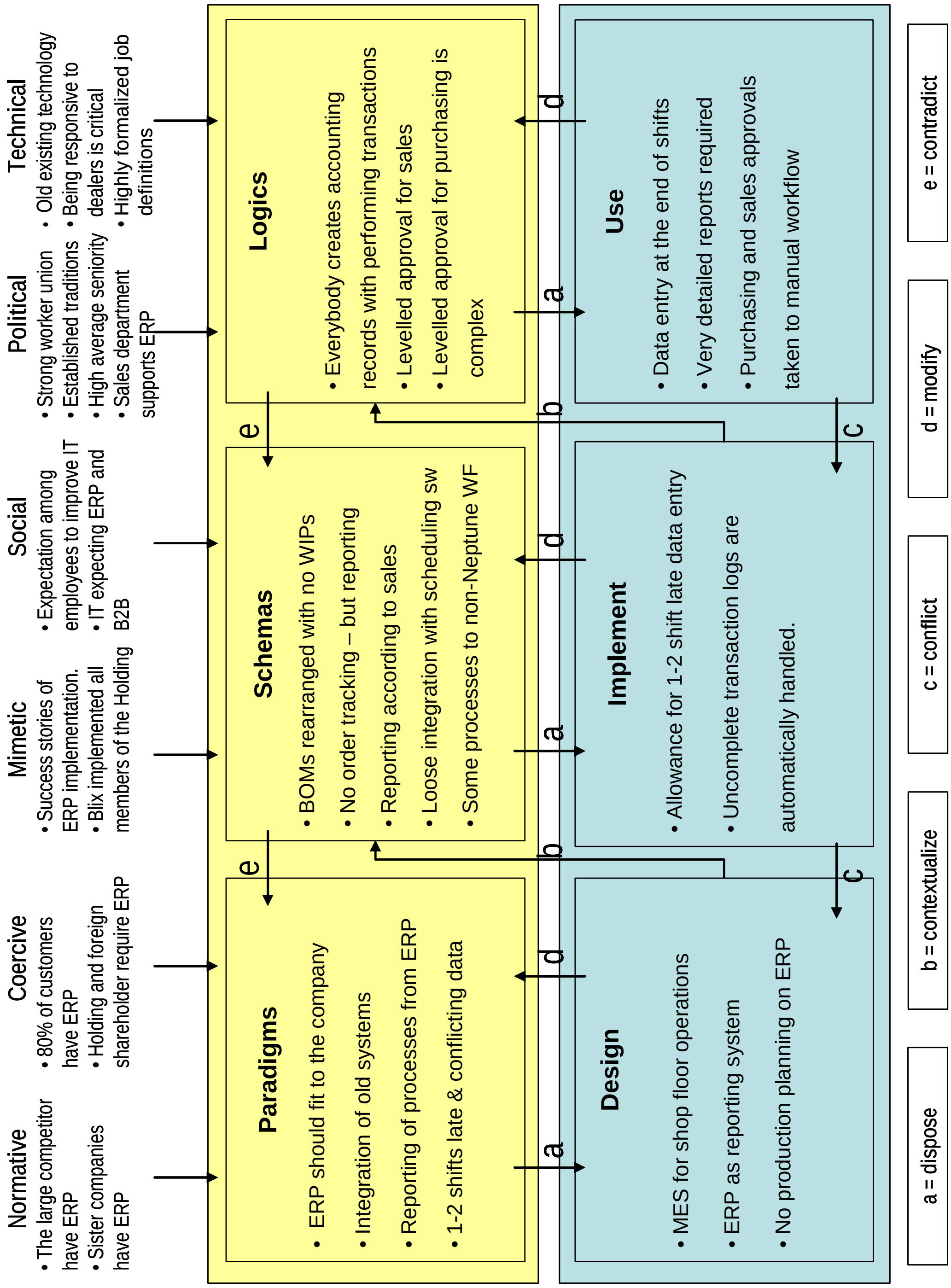
• Competitors have superior information systems
Coercive
• Regulations and stock market requires preceise reporting
• Owners want better corporate governance and accurate reporting
Mimetic
• Sister companies having / already have ERP.
• All large companies have ERP
Social
• ERP means problem.
Political
• IT director is replaced.
• New IT director was manger of a competitor of Delos
Technical
• Kappa could not provide existing data for importing due to technical problems
Paradigms
• ERP provides end-to-end best-practice examples but can be highly customized to better fit the company and can coexist with legacy systems in integration
Schemas
• Implementation schedules could be extended.
• Limits on number of additional developments and customizations can be exceeded.
• Microsoft Excel can be used for data entry to Mercury.
Logics
• Users have to accumlate data entry and transactions and perform them later over the system.
• Users should not record the data over text files and workbooks.
e
e
a 1
d
b
a
d
b
a
d
Design
• ERP design covers all company but can coexist with some of the legacy applications.
Implement
• Implement all user requirements by customizations and developments.
• Data upload interfaces implemented for Microsoft Excel workbooks
Use
• ERP use is near-line.
• Batch data entries and data imports over Microsoft Excel files.
c
c
a = dispose
b = contextualize
c = conflict
d = modify
e = contradict

ZETA CORPORATION


2000
2001
2002
Moved offices in Istanbul to the plant site
Search conferences for "sustaining growth" and leadership" leading to recognition of "defficiencies in Information Technology"
Specific search conference for IT people in Zeta on "What to do about IT" leading to ERP and ebusiness
Blix was contacted to provide a solution for ERP and Ebusiness. After discussions Neptune was selected.
Rumors about a software project that would cause a decrease in headcount"
Analysis of as-is business processess and requirements analysis started by Blix consultants.
Full-time implementation team was established and trained by Blix on Neptune briefly.
To-be processess designed targeting minimum changes in business processess
Implementation started with opposing views of whether software should be customized or not.
Neptune went live and testing started. Old systems kept running in parallell.
An agreement reached between implementation team and change request owners about the priority of changes. Some of the old systems ceased
Implementation of modules and customization discussions continued with issues like accounting records by users' transactions
B2B Portal started Adding a web front-end to the legacy applications but dealer Interaction has increased
Significant operational problems have arisen leading to hard discussions. Developers had problems to meet the change requests.
Production data that was inteneded to be online accepted to be entered late by 1 – 2 shifts
Integration schema for production scheduling software have changed for looser integration
Interrupted Transactions due to false insufficiency of resources started creating problems
Manual and semi-automated attempts to solve Interrupted transaction logs


2003
2004
2005
Transaction logs problem lead to potential interruption of production. Emergency import of material with aircargo to avoid interruption.
Implementation team was ordered to present the causes of the problem to top management and board of directors.
Bill-of-Materials adjustments attempted with +/- changes
Work-in-Process inventory cancelled in Neptune and shop-floor started to be considered as blackbox with new consultant
Production order confirmation logic in Neptune was cancelled.
Manufacturing Execution System implementation have started to control shop-floor and send data to Neptune.
Manufacturing Execution System implementation planned with loose integration with Neptune for reporting purposes.
A new workflow application implemented and some workflows taken out of Neptune
Neptune end-user licences decrased by 90 users and sold to another company in the conglomerate.
Neptune became a reporting medium with minimum operational users and transactions.


Normative
• The large competitor has ERP
• Sister companies have ERP
Coercive
• 80% of customers have ERP
• Holding and foreign shareholder require ERP
Mimetic
• Success stories of ERP implementation.
• Blix implemented all members of the Holding
Social
• Expectation among employees to improve IT
• IT expecting ERP and B2B
Political
• Strong worker union
• Established traditions
• High average seniority
• Sales department supports ERP
Technical
• Old existing technology
• Being responsive to dealers is critical
• Highly formalized job definitions
Paradigms
• ERP shouldn't be customized much
•One consolidated & central system
• Operation of processes on ERP
• Timely & correct data
Schemas
• Precise BOMs to follow WIP in detail
• Order – production – confirmation
• Reporting according to accounting
•Tight integration with scheduling
Logics
• Accounting department created accounting records
• Levelled approval for purchasing
a
b
a
b
a
Design
• ERP for shop floor operations, purchasing, production planning, material requirements planning and sales.
Implement
• Transaction created accounting records
• Incomplete transaction logs to review
• Data integrity on single system
Use
• On time data entry
• Limited set of reports for use
a = dispose
b = contextualize
c = conflict
d = modify
e = contradict



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Technical
• Old existing technology
• Being responsive to dealers is critical
• Highly formalized job definitions
Paradigms
• ERP should fit to the company
• Integration of old systems
• Reporting of processes from ERP
• 1-2 shifts late & conflicting data
Schemas
• BOMs rearranged with no WIPs
• No order tracking – but reporting
• Reporting according to sales
• Loose integration with scheduling sw
• Some processes to non-Neptune WF
Logics
• Everybody creates accounting records with performing transactions
• Levelled approval for sales
• Levelled approval for purchasing is complex
Design
• MES for shop floor operations
• ERP as reporting system
• No production planning on ERP
Implement
• Allowance for 1-2 shift late data entry
• Uncomplete transaction logs are automatically handled.
Use
• Data entry at the end of shifts
• Very detailed reports required
• Purchasing and sales approvals taken to manual workflow
a
b
c
d
e
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c = conflict
d = modify
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