Strategies for Dealing with Drift during Implementation of ERP Systems

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STRATEGIES FOR DEALING WITH DRIFT DURING IMPLEMENTATION OF ERP SYTEMS

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Abstract

Research on the relationship between Information Technology (IT) and organizations emphasizes the complexity of adaptation processes and the potential of drifting. Drifting means that an organization encounters unexpected circumstances that show the incompleteness and possible failure of an initial technological design without organizations having yet feasible alternatives. This conceptual and empirical paper investigates the origins and nature of drifting, and strategies for dealing with drift. Three strategies have been proposed to deal with drifting: control, incremental, and drift containment. We explore the third option that seems most realistic and relevant from an organizational point of view.

We empirically investigated how drift containment could be accomplished in practice in a multi-site ERP implementation project. Our results suggest three phases of dealing with drift. Organizations must first recognize when drifting occurs. Next, they must develop a dual focus. On one hand, they must differentiate between a project's overarching objectives (which remain relatively stable). On the other hand, they attend to and resolve their operational drifting experience. The dual focus thus means that while organizations stay focused on their objectives, they address the causes of drifting. During the final phase, lessons learnt during drifting resolution must be shared and applied to accelerate accomplishment of project objectives. Implications for research and practice are elaborated.

Keywords: IS implementation, strategy, drift

BACK TO CONTROL: STRATEGIES FOR DEALING WITH DRIFT DURING IMPLEMENTATION OF ERP SYTEMS

Introduction

"The causes (...) on which action depends are never uncontrollable, and any given effect is only necessary provided that the causes tending to produce it are not controlled."

J.S. Mill (1987, 13)

ERP systems have been frequently criticized for being rigid, massive and consequently hard to implement and control. Because of the integrated and ubiquitous nature, ERP requires adopters, implementers and users to define a common set of business rules, data standards, processes and procedures that span the entire organization (Alvarez et al. 2002, 10). ERP systems implementation differ from more traditional information systems implementation in terms of scale, complexity, organizational impact, and the costs involved (Grabski et al. 2003). Consequently, different types of problems may arise due to cross-module integration, data standardization, adoption of the underlying business model, compressed implementation schedules, and the involvement of a large number of users (Soh et al. 2000). Unsuccessful implementation may lead to decreases in profits, increase in inventories, budget overruns, high costs of ownership, and disappointing performances (Markus et al. 2003: 205; Motwani et al. 2002: 83). These problems will become even worse when ERP-systems are implemented multi-site and across national cultures (Soh et al. 2000; Walsham 2002).

Because of these organizational and cultural complexities, implementation trajectories of ERP-systems will often deviate from their planned purpose and may even get out of control. ERP implementation then becomes a risky endeavor (Grabski et al. 2003). Ciborra et.al. (2001: 4) have called this deviation phenomenon 'drifting'. **Drifting – like a ship that starts drifting – means that an organization encounters unexpected circumstances that show the incompleteness and possible failure of an initial technological design without organizations having yet feasible alternatives**. Drifting is a condition of organizations. As long as an organization design and set of procedures fit the circumstances, and people execute these structures coherently and as intended, organizations operate in a controlled manner.

Because of the high promises (and the large investments that are associated with it) but often disappointing performances of ERP systems, extensive research has been accomplished in order to 'discover' the origins of drifting of these large integrating information systems. This research is part of the still growing body on IS failures (Davis et al. 1989; Lyytinen 1987). However as Sauer (1999) observes in his historical overview of research on information systems failures, little progress has been made during the last three decades. This might be due to the domination of the risk control approach in IS implementation. Control – here considered in the context of technology implementation – can be viewed as the counter-concept of drift. **Control has been defined as purposive influence toward a predetermined goal (Beniger 1986: 39), or as attempts to ensure that individuals working on organizational projects act according to an agreed-upon strategy to achieve desired objectives (Kirsch 1996).** In fact, control activities are aiming at a 'surprisingless future' in the sense that they try to foresee the consequences of technological change during the implementation process. Control is thus aimed at preventing technologies to drift and to reduce the risks associated with drifting.

However, as recent research suggests, organizations that stick to the traditional risk control approach are likely to face the paradox of control (Hanseth et al. 2001; Strong et al. 2003). On one hand, the ubiquitous standardization of business processes enhances organizational control. On the other hand, control becomes less as the ERP system becomes larger and harder to change and adapt (Hanseth et al. 2001; Sia et al. 2002). Scott and Vessye (2003: 242) believe that failure, at some level, or in some areas of implementation, is inevitable. In fact, Schwartz Cowan (1990: 279) concludes “they (i.e., failures) are as inevitable as death and taxes”.

In this paper we deal with the issues of control and drifting during ERP systems implementation processes. Literature suggests two dominant approaches to drifting, and one emerging strategy. The first approach is a control strategy, aimed at eliminating drifting and risk. We will argue and show that drifting is to a certain extent unavoidable. The second strategy considers drifting a normal part of technology implementations. ‘Bricolage’ is developed as a concept to conceptualize an organization’s ongoing and unique adaptation of technology to its context (Ciborra et al. 2001a). This strategy, however, tends to ignore the rigid constraints faced by IS implementation teams, and the expectation that implementers will be in control. The third strategy recognizes the inevitable occurrence of drifting in technology implementations. Drifting may even contribute to stabilization of projects (Holmström et al. 2001).

This third approach – which we call drift containment strategy – is still recent and lacks embedding in the current literature on control and IS failure. An important question is how can organizations balance control and drifting, and how drifting can contribute to stabilization of implementation project if a large body of literature is aimed at the opposite – avoiding drifting.

The objective of this conceptual and empirical paper is twofold. The first is to gain a better insight into the origins and nature of drifting. For this reason we review recent research on IS implementation in general and on ERP systems implementation more specifically. The second aim is to show how organizations deal with drifting in a contained manner in the sense of regaining control instead of letting projects escalate.

The paper is setup as follows. We review past research on IS implementation failure and drifting. Next, we explore specifically drifting as a phenomenon, followed by a review of the three strategies to deal with drifting (control, incremental, and drift containment). We then present the results of a qualitative study on a multi-site ERP implementation. The paper concludes with implications for research and practice.

Studying Drift

The concept of technology drift has been originally coined by Winner (1977: 88) while discussing technological determinism. In his view it should be seen as a state of affairs resulting from a multiplicity of technologies “acting and interacting in countless ways beyond the anticipations of any person or institution” (Winner, 1977: 89). Due to the increasing speed and extent of technological innovation societies face the possibility of “going adrift in a vast sea of “unintended consequences”” (Winner 1977: 89).

Research into the origins of drifting of information systems and its unintended consequences over the last three decades not only has yielded a wide variety of 'explanations' for drifting but also different theoretical views on technology implementation: factor research, phase model research, actor-research, and interaction-context research. We present and critically examine each perspective in order to investigate causes of drifting.

Factor research

First, to gain insights in the organizational complexity of drifting, many researchers have tried to identify individual or a correlate of factors that thwart a smooth implementation process. This type of research largely builds on Rogers' (1995) seminal work on the diffusion of innovations in which he has studied many innovations characteristics, adopter characteristics, organizational characteristics, and environmental characteristics and their relationship with implementation and performance (Bradford et al. 2003: 207). Other researchers have extended the number of independent variables to explain the failure or success of implementation of ERP systems (Esteves-Sousa et al. 2001; Motwani et al. 2002). Holland and Light (2003) have built a critical success factor framework in which they distinguish between strategic and tactical factors. With ERP implementations, the authors argue, additional factors must be taken into account compared to standard project management critical success indicators.

In spite of its popularity among researchers, diffusion factor research shows some serious weaknesses. First, most factors that have been identified in this type of research are not technology-specific but apply more or less to most implementation processes. For example, saying that top management support is thought to be a vital success factor is not very informative about the specific actions undertaken and roles top management has played in a particular implementation process. Hence, there may be consensus among researchers about the influence of different diffusion factors at a generic and abstract level, yet it appears hard to find a consistent set of variables that can explain and predict implementation success or failure for different kinds of technologies and different types of organizations at a more concrete level (Borton et al. 1993). Moreover, identification of diffusion success factors may erroneously lead to the believe that managers have full control over these factors (i.e. they can change them at will), and that these factor are causally linked with a successful project outcome.

Phase model research

Second, in normative ERP implementation research, implementation is described as a linear process, split up into different phases. This makes the new technology gradually acceptable to the organization and manageable to those who are responsible for the implementation process. Each phase is characterized by its own managerial and organizational problems and therefore successive steps need to be taken in order to overcome these problems. When these problems have been solved, a new phase can be entered. In the last phase the technology has become embedded in the organization.

In recent years planned phase models of implementation are criticized for ignoring the organizational complexity and for enforcing this complexity into a straightjacket of a simplified projected future. They aim at standardizing organizational processes and practices into a deterministic and patterned logic of predicted change (see for overview of criticism on phase models: (van Dissel 1999)). Moreover, this type of research assumes that an ERP system is an invariant technology that does not change as it is diffused and put into use. Waarts et.al. (2002) criticize the static perception of technology in most innovation research as it measures the influence of different factors at a particular point of time ('one-shot adoption studies'). Their research shows the shifts in diffusion stimulating factors over time. While in the first stages of diffusion more strategic factors influenced the diffusion of ERP systems, in later phases emphasis was put on practical implementation issues (Waarts et al. 2002). Normative models make it hard to view successes and failures other than through normative lenses (Jones 1999).

Actor Research

The third stream of research emphasizes the critical role human actors play in the implementation process. We discuss in this category the Technology Acceptance Model (TAM), resistance perspectives, and technological frames.

TAM was originally developed by Davis (1989a, 1989b) and conceptualizes the motivation and behavior of the end-user of an information system. In the chain of decisions that are made in the adoption and implementation processes, end-users decide whether they use new technology or not. TAM assumes a rational actor considering using or refusing to use the new technology on the basis of two crucial criteria: perceived usefulness (PU) and perceived ease-of-use (PEOU) (Davis 1989; Davis et al. 1989). Actual choices on the use or refusal to use particular technologies may differ from intended use (e.g. the one who decides on the purchase of the technology) and may therefore result in drifting technology. The TAM provides a useful diagnosis tool as an 'early warning' technique to predict whether a new system will be acceptable to users and to take corrective action to increase acceptability (Davis et al. 1989).

An important weakness of user acceptance research is that control and drifting of technologies are exclusively explained by the individual choices while disregarding the social context in which the individual is participating. It implies that TAM can be a powerful approach to explain differences in technology acceptance at the individual level, but fails to give insights in the choices and acceptance at the collective level. In response, Schwartz Cowan (1990) emphasizes that attention should not solely be paid to the individual consumer/end-user of the technology, but argues that consumers are embedded in a social network of relations that limits and controls the technological choices that people are making (Schwartz Cowan 1990).

Instead of TAM's focus on user-acceptance, other actor research scholars pay attention to the ***resistance*** of potential or thought-users to new technologies. Following Bauer (1995: 14), resistance can be defined as activity that is unexpected in both content and form by innovators. As organizations develop routines around the use of new technologies (which give rise to a self-enforcing cycle of stability), these routines may become sources of resistance (Edmondson et al. 2001). Resistance can be viewed as a form of risky behavior as it violates existing rules, norms and predicted goals and achievements. Because of this unexpectedness and risk that are involved, implementation of new technology becomes a risky activity. In contrast to technology acceptance (TAM), for which there is a clear point in time at which a person rationally (cost-benefit) decides to accept (use) a particular technology, it appears hard to find a similar 'concrete' decision on resistance. Resistance contains a range of actions with on a continuum of accepting-resisting the new technology (Miles and Thomas, 1995). Accordingly, resistance varies in intensity, from active to passive and from individual to collective. Miles and Thomas (1995) argue that in the case of IT the intensity of resistance is, compared to other new technologies, low and mainly local, informal, individual, and passive. In many instances it is not the technology that is resisted but the perceived consequences of implementing a new technology. In the case of IT these objects of resistance may be control and misuse of information, loss in the quality of working life, de-skilling, changing job structures or the poor quality of interfaces.

While Schwartz Cowan (1990) stresses the importance of a conforming influence from the social network on technology *choices*, other researchers have put emphasis on technology as an *outcome* of diverging and competing ***technological frames*** (Orlikowski et al. 1994). Here the argument is that multiple social groups may understand and interpret technology in different ways (interpretative flexibility) and therefore make different choices if and how they may use the technology. Technological frames are defined as a core set of assumptions, expectations, and knowledge of technology collectively held by a group or a community (Orlikowski et al. 1994). Technological frames not only include the role of technologies itself, but also the specific conditions, applications, and consequences of that technology in a particular context. In their detailed case study on the implementation of a groupware system. Orlikowski and Gash (1994) found incongruence between the technological frames of technologists and users, leading to incompatible actions around the technology which made the implementation of the system more complicated than expected.

The strength of the technological framework theory is that it provides an adequate heuristic framework for analyzing conflicting perceptions of different social groups and consequently for observing the hard and complicated trajectories of technology implementation. However, as the authors argue, it should be complemented to include institutional analyses of structural, cultural, and political issues. Important questions remain unanswered, such as how and why do technological frames emerge in organizations, how they gain legitimacy in organizations, how technological frames change over time, and why some particular technological frames gain power over other frames. By leaving out technology these social constructivist analyses may lead to the rather naïve conclusion that one can reap the direct and intended (enabling) effects at will while selectively leave indirect and unintended (constraining) effects aside.

Interaction-context Research

Finally, two alternative implementation research approaches have been developed recently: structuration theory research and Actor Network Theory.

In **structuration models** of technology, explicit attention is given to the interaction between technology, human agents and institutional properties of an organization. The basic premise here is Giddens' (1986) concept of the duality of structure, in which the structural properties of social systems are conceived both medium and outcome of the practices they recursively organize (Giddens, 1986: 25). Giddens provides a theoretical solution to overcome the dualism between objective, structural characteristics of organizations on one hand, and subjective, knowledgeable actions of human agents on the other hand (Orlikowski 1992). The main contribution of IS research from a structuration theory perspective was the insights it yielded in the complicated nature of the interaction between human agents, technology and organizational properties. Also, the theory showed that appropriations during the implementation process make it hard to completely control the development and use of information systems. This perspective changed our view on technology as a fixed artifact towards something that has emerging properties and which may give rise to unintended consequences when it is used in a particular organizational context (i.e. drifting). Moreover, structuration theory explicitly points not only to the enabling and but also the constraining implications of use of information systems (Orlikowski et al. 1991).

Although structuration theory provides interesting insights into the origins of drifting, there are still some important issues to address. The most important point is probably the fact that structuration theory does not have a clear theoretical and conceptual view on the hard (material) part of technology. The question then is: To what extend is this hard part of technology open to multiple interpretations? As Jones (1999: 127) argues, some material properties of information technology such as power supplies, screen resolution, processing speed may be only indirectly interpretatively flexible. Hanseth and Monteiro (1998: 96) argue that it remains unclear how specific elements and functions of information systems relate to organizational issues. They alternatively suggest applying Actor Network Theory for studying the development of information systems in organization.

The main idea underlying **Actor Network Theory** (ANT) is that all linked and influencing elements, both technical and non-technical, should be included when studying the development of information systems in organizations. According to ANT researchers there is no legitimate reason why elements (actors) should be excluded that influence the course of action. This implies that technology is also viewed as actor in the network. Two basic concepts are used to describe and analyze the evolution of the relationships between the constituencies of heterogeneous networks: inscription and translation.

- *Inscription* refers to the way technical artifacts embody patterns of use, and is used to describe how anticipation and restriction of future patterns of use are used in the development of technology (Monteiro 2001). By inscribing programs of actions into a piece of technology, the technology becomes an actor, which imposes its inscribed program of action on its users (Hanseth and Monteiro, 1998: 98). Inscriptions may vary in strength. Strong inscriptions leave little room for interpretative flexibility (i.e. unintended consequences), which means that using the technology in an alternative way is accompanied with high costs.

- *Translation* then refers to the process in which actors re-interpret, re-present, and appropriate each other’s interest to their own. Translation also refers to the process in which the meaning of the technology is negotiated with the specific needs of the context. By this process of translation the technology becomes embedded and routinized into the context of use. This process thus produces stability and social order.

The strength of ANT theory is that is allows for detailed analyses of the evolution of the complete set of elements related to technology development in organizations. The strength of ANT, compared to structuration theory, is that it attempts to conceptualize the role of technology more explicitly. Moreover, while structuration theory was not explicitly developed for analyzing the role of technology in society, ANT equips us with interesting concepts to do this. The weakness of this approach is probably that the number of constituencies of the network may be endless and that there are no criteria to determine what and who should be included. Another weakness is that its conceptualization of technology as an ‘actor’ in a network is somewhat confusing and somewhat misleading. At least the differences between the different actors in heterogeneous networks should be nuanced.

Understanding Drift

Our discussion on the different strands of research on technology implementation demonstrates that our understanding of the causes of drift is still incomplete. In his well-known study “Beyond Mechanization” Hirschhorn (1984) states that machine systems inevitably fail “given the realities of materials and human behavior. Once we accept failure as a part of technological reality, we will gain a clearer perspective on postindustrial work” (Hirschhorn 1984). This implies that uncertainty, unpredictability, and uncontrollability are inherently accompanied with complex technology implementation as it, in most cases, produces more consequences than was intended (Winner, 1977).

For our understanding of drift we take a few notions of the theories discussed above.

First, implementation can be defined as the incorporation or routine use of a new technology on an ongoing basis in an organization (Edmonson et.al, 2001: 686). The success of implementation depends on the extent to which the new technology disrupts the current routines in the organization, and the duration of this process. Organizational routines refer to 'the repeated pattern of behavior bound by rules and customs that characterize much of an organization's ongoing activity' (Edmondson et al. 2001). They should not be seen as unchangeable and mindless organizational structures but as 'effortful, emergent accomplishments' of people who think and care (Feldman 2000). Like in structuration theory, routines, on one hand, embody the abstract idea of structure, while on the other hand, they consist of agency (actual performance) (Feldman et al. 2003). Organizational routines are based on organizational-specific knowledge which is to a large extent tacit and collective.

Second, technology is abstracted, disembedded knowledge that is to some extent emptied from its space-time bounded meaning. At the same time technology is embodied and inscribed knowledge, which implies that it has material substance and a preferred use. Disruption occurs when conflicts arise between the different images of knowledge and work practices, caused by time-space discontinuity of the new technology and organizational routines. Orlikowski (1992: 407) argues that this time-space discontinuity is caused by the fact that actions that constitute (we suggest in the ANT tradition to use the word *inscribe*) the technology (e.g. vendor organizations) are often separated from the actions in which the technology is applied (user organization). She distinguishes between the design mode and the use mode. In the former human agents build into technology certain interpretative schemes, facilities, and norms. In the latter they appropriate technology by assigning shared meaning to it, which in turn influences their appropriation of interpretive schemes, facilities and norms (Orlikowski 1992). This distinction between design mode and use is not just an analytical convenience as Orlikowski (1992) argues, but the two modes, although they may interact intensively, are real as they refer to different knowledge practices and contexts. It implies that there exists an epistemological gap between design and use contexts which cannot be fully bridged.

Third, following ANT premises, we cannot claim that technology is meaningless unless it is instantiated, as it represents inscribed behavior of particular actors in the network. Each new technology is inscribed with a preferred use and evokes a certain response, varying from resistance, non-usage, deviated usage, to compliance with preferred usage.

Finally, the extent to which the adoption of new technologies disrupts organizational routines and will cause drift depends on the time-space discontinuity. The more actors are involved in the same time-space bounded actor network, the greater the chance, by means of translation, that interpretative commonality will arise on the meaning and use of the new technology (Hanseth et al. Forthcoming). Or reversely, when spatial and temporal distance between different actors in the network increases, interpretative flexibility (unintended consequences) and drifting will increase as well.

Dealing with Drift

One important notion in studying drift is that the unintended consequences should always be linked to the intended consequences. Or as Giddens (1986) puts it, unintended consequences should always be interpreted "within the flow of intentional conduct" (1986: 285). Drifting is not an invariable and independent outcome of the adoption and implementation of new technologies, but primarily a gap between the intended and unintended consequences. It also means that drifting should not be conceived as a technology becoming autonomous, following its inscribed, internal logic. It implies that research on implementation should not only focus on controlling and reducing risks (unintended consequences) but also on different strategies for dealing with drift (intended consequences).

Based on recent literature we distinguish three different (ideal) types of implementation strategies: *control strategy, incremental strategy,* and *drift containment strategy*.[1] By implementation strategy we mean the planned and intended course of actions taken to implement a particular technology. We present the three types of strategy and analyze them guided by the following organizational processes commonly distinguished in IS implementation literature: communication, learning, and knowledge management.

- *Communication* is conceived to be a crucial activity for the adoption and implementation of information systems. Rogers (1995: 17) defines communication as the process by which participants create and share information with another in order to reach a mutual understanding. Through communication potential users are influenced about the relative advantages of new technology and are persuaded to adopt it (Attewell 1992). As a rule, the better the mutual understanding, the greater the chance for acceptance and the faster the rate of diffusion of the innovation. Communication activities may differ to the extent that they are aimed at enhancing or delimiting alternative solutions.
- *Organizational learning.* The role of individual and organizational learning in implementation processes of new technologies have been emphasized frequently by researchers of innovations. Individual learning refers to the distillation of the experiences of an individual regarding a technology, whereas organizational learning refers to the acquiring of individual insights and skills that have become embodied in organizational routines, practices, and beliefs that outlast the presence of the originating individual (Attewell, 1992: 6). As Attewell argues, there is no direct correspondence between these organizational routines and the individual's understanding of the new technology. More over the link between learning and experience is often lost to the organization. This implies that the individual learning experience that gave rise to a particular organizational routine may be lost, while 'lessons' remains instantiated in the organizational routine.

  In the case of implementing complex technologies which are multifaceted and with interactions and interdependencies with other elements of the organization, it will become impossible for the designer to know in advance how the technology will perform when it is put into use. For this reason it makes sense within an implementation strategy to differentiate between programmed learning and adaptive learning. In *programmed learning* an ex ante transfer of knowledge is intended from the originator to the user, who is expected to learn about the new technology to apply it in a particular way. Abstracted knowledge is acquired in the learning context that is separated from the context of application (Gibbons et al. 1994). In *adaptive learning* takes place in the physical and social context in which the technology is employed (Tyre et al. 1997). The learning

[1] Inspiration for this distinction between three types of implementation strategies comes from Sauer's (1999) three ways of approaching IS development and implementation: risk control, risk containment, and incrementalism.

emphasizes discovery through enactment and interpretation and leaves room for variation in finding to context-specific solution (Gunther McGrath 2001). Knowledge and skills about the technology use are acquired by learning by using and are rooted in experience (Rosenberg 1982).

- *Knowledge management.* An important weakness of most organizational learning approaches is that they fail to address the ‘management’ of knowledge that is learned in organizational processes (Nonaka 1994). In the case of implementation strategies this means that new knowledge that is acquired is not consciousness collected, stored, and distributed in the organization. In other words, each participant has to re-invent the wheel. Cultivating the organizational memory on implementation issues might help the involved actors in the network to take advantage of the new insights that have been gained at a particular time and place.

We now present and analyze the three IS implementation strategies: *control strategy*, *incremental strategy*, and *drift containment strategy*. Table 1 summarizes our findings.

Table 1 Comparing the three strategies for dealing with drift

	Communication	Organizational learning	Knowledge Management
Control strategy	Communication activities aiming at getting the same ('best') way to conduct the project.	Oriented to programmed learning to prevent people deviating from the project planning.	Up-front collecting of information in order to inform people before the project starts.
Incremental strategy	Interactive communication activities aimed at finding solutions to local problems.	Oriented to adaptive learning to solve local problems.	Oriented toward knowledge creation and sharing for application in the immediate implementation practice.
Drift containment strategy	Interactive communication activities aimed at finding solutions to local problems and to connect to strategic intentions.	Oriented to adaptive learning to solve local Problems, while at the same time reflection on local implementation practice.	Oriented toward knowledge creation and sharing for application in the immediate implementation practice. Creating new knowledge during the implementation process that might be useful in new projects.

Control strategy

The first strategy assumes that risks of drifting can and should be avoided by those responsible for the implementation at the center of authority. They can accomplish this by formulating their intentions as precisely as possible and then strive for their implementation with a minimum of distortion (definition adapted from (De Wit et al. 1994)). Organizations structure their activities and assume that when people execute these structures faithfully drift will be avoided (Snook 2000). This approach is characterized by words like *roll out, structure driven organizing, one size fits all, lists of factors/ causes, extensive training, excluding surprises, reducing the unknown,* and *creating an overseeable world*. To this end measures are introduced like methods, planning, and homogeneous discourse (Räisänen et al. 2004).

Organizations tend to define clear targets, objectives, and comprehensive planning. This is implemented through extensive knowledge sharing and training that attempts to foresee any possible obstacle. A concern with this approach is that sometimes the underlying causes of drifting are ignored. People tend to quasi simplify situations which is unrealistic. However, striving for a perfect implementation is neither impossible nor feasible, people can't foresee everything. Organizations must learn to adjust their structures, they must bend slightly to real-life circumstances in order to avoid coming sooner or later to an undesirable stop (Holmström et al. 2001; Keil 1995).

Knowledge management initiatives aim at collecting more detailed information about user-needs, organizational and environmental specifics. Collecting detailed information about the requirements only makes sense if the contextual conditions under which the implementation takes place are stable and do not create new information needs. To prevent these conditions become unstable, formal and informal controls are instituted to ensure pursuit of the intended consequences. In most cases this implies that rules for implementation are imposed on actors that are involved in the process by, for example, restricting the options open to them (limiting access to applications and/or information, excluding potential users). Communication is directed towards the establishing of a common understanding of the preferred use of the new technology. Learning takes place ex ante, ‘off stage’, and aims at limiting the range of alternative solutions. No knowledge management initiatives are taken during the implementation process as it is assumed that the information that is needed is already available (and transferred in the ex ante training programs).

Incremental strategy

The underlying assumption of the second incremental strategy is that the course of the implementation process cannot be fully predicted and controlled. The mood of this approach is captured – maybe with some exaggeration – in words like *go with the flow, learning, letting things happen* and *we have to live with it*. Technology and agency must mutually adapt, the sources and nature of this process seem intricate. In this view drifting and unanticipated events are accepted as unavoidable and unpredictable. Instead of enhancing control it is argued that adaptive capabilities are required from the part of the actors. One of such crucial organizational capabilities is improvisation. This organization mode is conceived to be the key success factor that can hold together a faltering organization (Ciborra 1999). Improvisation is a highly situated activity. Another organizational capability mentioned in Ciborra’s work is bricolage, which refers to the tinkering through combination of resources at hand. In bricolage the practices and situations disclose new uses and application of technology (Ciborra 2002). In this spirit, hacking is a technical capability aimed at devising and implementing a technology in an original and unorthodox way.

The power of these three incremental tactics (improvisation, bricolage, hacking) is that these activities are highly situated and try to exploit the local context and resources at hand. In contrast to control strategies, incremental strategies refrain from limiting interpretative flexibility and open up for alternatives by stimulating serendipity and open experimentation to accommodate to the idiosyncratic implementation context. Communication and organizational learning initiatives are not taken ex ante but in situ. Solutions are created and communicated as problems appear. Knowledge management initiatives aim at collecting and sharing knowledge and to be applied in the immediate context.

Incremental implementation strategies, in particular the radical versions, are open-ended; they progress (or regress) without a purpose and without a timeframe. Improvisation, bricolage, and hacking may be useful to solve practical problems and allow for changing organizational routines but might give way to endless and purposeless reinvention of information systems. The problem with this incremental approach is that unintended consequences become disconnected from the intended consequences or that no attempt is made to establish dialogue between the two. The result might be that the organization finds a mode to institutionalize the new technology but fails to accomplish that within the organization’s resource constraints (budget, time).

Drift containment strategy

In the third drift containment strategy, drifting is time-space bound within a wider framework of intended consequences. This strategy builds on the assumption that drift can play a necessary role to accommodate to the idiosyncratic context and multiple interests of those who are involved in the implementation process (Holmström et al. 2001). While the organizational processes are quite similar to those of the incremental strategy, they are tied to a control strategy framework. Drift containment pays particular attention to transition activities (communication, learning and knowledge management) that connects control and incremental strategies. Within the drift containment strategy, control and incremental implementation are defined at different operating levels. It means that direct control is not necessarily exercised at the level of the implementation practice but at the higher level of intended consequences.

Like in the incremental strategy, communication and learning are not directed to achieve a common understanding of the initial, preferred use of the technology, but to learn the context-specific problems and to find solutions. However, the most important difference compared with the incremental strategy is that they also allow for reflexive monitoring of the implementing activities (Giddens, 1986: 5). It is through this reflexive monitoring that those who are involved in the implementation process connect to the intended consequences that are defined at a higher level. This keeps people in touch with the wider strategic context in which the goals are settled. We consider knowledge management potentially the most important reflexive monitoring activity as it tries to capture and reformulate the knowledge that has been created during the implementation process.

Whereas control and incremental strategies are primarily one-directional, aiming at the institutionalization of the new technology into the organization, the drift containment strategy is inherently dialectical through a continuing dialogue between high-order organizational goals and local implementation practice. It does not mean that the intended consequences will remain completely the same, yet they provide a basic beacon of stability during potentially complex implementation experiences. In reflexive monitoring implementing practices are constantly examined in reformed in the light of new incoming information and therefore may constitutively alter the original intentions (Giddens 1991).

What remains unclear, however, is how drift containment could be accomplished in practice. Specific questions include: what phases do organizations go through, how do they combine control and improvisational aspects of drifting, and how can organizations regain control. We empirically investigated these questions in a multi site ERP implementation project that drifted on a few occasions. After elaborating on the methods of our study, we present and analyze the findings.

Methods

Motivation and design

Drifting is an uncommon phenomenon in research. In fact, only a few studies exist that refer to it. The exploratory nature of our empirical research question – how do organizations contain drifting – encouraged us to adopt a qualitative research approach (Yin 1994). We selected the case study methodology as a form of qualitative research to focus in depth on a specific instance of IS project drifting (Myers 2001/ 2003). Researchers are commonly advised to consider the case study method when they are studying contemporary phenomena.

The reason for selecting the DiskCo case was the likelihood that drifting would occur. Drifting as a phenomenon is based on our earlier mentioned definition of the concept. We were looking for an IS context where drifting is likely, and turned our focus towards packaged software implementations. This became a natural choice given the abundance of recent literature on the complexity and difficulty of these projects (Davenport 1998; Soh et al. 2000). We further narrowed down to multi-site projects as this increases the chance of implementation challenges and drifting (Markus et al. 2000).

The in-depth character of our design implied a limitation in terms of the number of case studies. We chose a single case study approach to leverage the advantage of exploring drifting in a unique setting, rather than contrasting multiple case studies that would have been executed in a more superficial manner given the availability of resource. A single case study design enables theory building and conceptual generalization (Eisenhardt 1989; Yin 1994).

The DiskCo case featured an embedded case study design (Yin 1994). This means that in addition to our central unit of analysis (the multi-site project under investigation), we paid attention to other levels, such as phases, individual perspectives, and intra site phenomena.

Following Eisenhardt (1989), the case study was not designed as a grounded study. We delved deeply into theory on organizational drifting in order to develop a conceptual lens, and to answer our research question as completely as possible before embarking on empirical work.

The exploratory nature of our research question implied a semi-structured setup of our data collection method as will be explained in the next section.

Data collection

The first author conducted interviews using a research protocol and semi-structured interview questions, assisted by a graduate student. The protocols provided focus and helped guide the research. During the actual data collection some questions were refined. Proceeding insights in the case situation enabled more focused questions. Table 2 lists the interviews at DiskCo. The interviewees were selected after discussing with a company representative our research interests. Multi-site IS implementation projects offer ample opportunities for selecting interviewees by site, organizational level, and functional area (IS or business functions). As the table shows, we managed to interview people from multiple sites in Singapore and Malaysia, multiple levels (executive, director, staff), and multiple functional areas (IS staff and key users from non-IS departments). Interviews were conducted face-to-face unless people were located outside Singapore HQ (i.e., Singapore site E, Malaysia). In that case we arranged for a teleconference.

Table 2 Interviews DiskCo Case

Unit & Site	Functional Area	People & Role[2]	Number of interviews
Singapore site A (HQ)	Information Technologies	CPW, Vice President	3
		HHT, Director Applications Development	3
		OBT, Member Oracle Conversion Team	1
		JPL, Member Oracle Conversion Team	1
		SCC, Member Oracle Conversion Team	1
	Finance	ST, Key user	1
	Material & System	JLL, Key user	1
Singapore site E	Information Technologies	GP, Member Oracle Conversion Team. Temporarily stationed here from Singapore site A	1
Malaysia site A	Information Technologies	JNL, Project Manager Data Conversion Team	1
		MC, Member Data Conversion Team	1
	Finance	SKL, Key user	1
	Inventory Control	ET and some colleagues, Key users	1
Total number of interviews			16

During interviews, ideas were almost permanently jotted down to capture ideas that popped and represent relevant information on the interviewee, the interview content, and the interview process. After interviews, results and notes were discussed and reflected upon with a graduate student who participated in data collection. This inspired us to re-ask questions for clarification, and ask the same question to other people. We gradually refined the focus of the research and data collection while staying within the original structure of the study. All notes made during interviews were collected and stored; all interviews were transcribed for further analysis.

Data collection encompassed data sources beyond the formal interviews as recommended by Yin (1994). During two weeks the first author and graduate student participated as observers in the organization when not interviewing. We had numerous informal conversations with people involved in the project at different levels of the organization. This included going out for lunch and moving around, all aimed at improving awareness of the situation.

[2] Names are abbreviated to maintain confidentiality.

Other data included corporate documentation (photo copies of documents, and large amounts of digital intra organizational files). As a historic trail, these resources give insight in events and policies important to the project and therefore the research.

Data analysis

Following Yin (1994), we carefully organized data to make it readily accessible for analysis by multiple researchers and from multiple angles. Most data was and is centrally accessible in digital format.

As a first step, a case narrative and initial, raw analysis was completed and fed back to DiskCo. The comments we received on this first draft were incorporated in the next version. This practice enhances construct validity according to Yin (1994), and highlights the uniqueness of the setting (Klein et al. 1999).

We then engaged in an intense period of reading the data and selecting quotes relevant to our research objective. While this intellectual search process is challenging to describe, it involved practices like creating graphs, time paths (Miles et al. 1994). We constantly worked on selecting and analyzing quotes from different angles, and revisiting theory. Ultimately, we searched for words that enabled us to select relevant quotes. For drifting, this includes words like “expected”, “change”; for a control strategy words like “plans”, “control”; for an incremental strategy “adaptation”; and for drift containment words like “back to control”, and “stabilize”. At the same time, we remained open to different words and types of sentences that could point at the concepts relevant to our study. For instance, the following quote was categorized as pointing at a control strategy because the interviewee uses words like “structured”, and “method”.

> *“This methodology helps a lot in the sense that because we had never done such an ERP implementation before, not for my self. (…) I think it is quite a structured way, a method, and it really fits very well. I think the method is really derived in such a way that it is a good fit for any organization who wants to do the Oracle ERP implementation.” - HHT, Director Applications Development, Singapore site A (DiskCo-B-1)*

Quantitative measurement of quotes as used in some qualitative studies (Edmondson et al. 2001) was considered but not adopted since we did not benchmark the study against alternative cases, nor did we conduct a detailed chronological study.

Authors’ selection and interpretation of data was independently completed and cross-checked to promote internal validity (Yin 1994). Contrasting experiences and interpretations were brought up in discussions between the authors, and sometimes involving other researchers. This meets the multiple interpretations principle suggested by Klein and Myers (1999). Eventually, the analysis process stabilized towards the current final interpretation as presented in the findings and discussion section.

Description of the case study

DiskCo is the focal organization of this study. The multinational company is headquartered in the US. Manufacturing plants are located in China, Malaysia, and Thailand. The Far East headquarter is in Singapore where many products are also assembled. The company offers solutions for data storage and processing to individuals and business. DiskCo’s activities include two main categories: physical products (disc and tape drives), and software. We focus on the former category that is organized around disc drive and media operations. The company relies on tightly integrated vertical supply chains that start at production facilities in the US, Europe and Asia for large volumes. Distribution and sales is organized around a global network of DiskCo sites and partner organizations. R&D is located in Singapore, and a couple of sites in the US. Our study focuses on the multi-site implementation in the Far East, because our primary access point for data collection was there.

DiskCo started in 1994 a strategic project to encounter the year 2000 problem. The firm decided in 1995 to implement an ERP system across its global sites, and started with sites in the US. Far East and European sites commenced in 1996 and completed the project in 1999.

The initial master schedule dictated a tight sequence of implementations based on the fixed end date: the Y2K problem. In reality, implementations had to be delayed to cater for learning effects and site specific needs. The final site - Japan - was ready just in time by June 1999. The Y2K problem would already start to have an impact form July 1999 onwards.

Singapore HQ therefore took the responsibility for Far East implementations with the exception of Thailand. They were assisted by the US, resulting in a mixed strategy on a global level. DiskCo adopted a “core team” approach. This group consists of IT specialists and key users (user representatives). Their membership of the same team promotes cross-functional collaboration. Key users liaise between the core team and users in their functional area. They also maintain contact with (key) users at other sites. For instance, (key) users in Finance. From outside DiskCo, Oracle consultants and trainers were involved. In Singapore and Malaysia, they trained local IT staff and key users. DiskCo adopted Oracle’s Application Implementation Method (AIM), and later the Software Development Life Cycle (SDLC).

The master plan is elaborated on a regional and functional level. The regional fine-tuning for each site is done by project executives and directors. At the same time, functional communities - like Finance, Engineering - coordinate implementation of modules on a global level. The plan is a living document: when sites cannot meet the schedule, they will contact local managers, who will escalate requests for a delay to regional executives. These people will contact the DiskCo CIO in the US to consider adjustments.

Case Study Findings

The pressure to perform: an organization compelled to avoid drifting

DiskCo’s worldwide implementation of the Oracle ERP system commenced in the US in 1997. The company struggled with the new technology that had to be mapped against current practices. At this time, representatives from European and Asian sites were involved. DiskCo’s Singapore site would become the coordination center for the Far East region. Executives from that site participated therefore in meetings on the implementation project. On an operational level, there were some contacts to promote knowledge absorption from US experiences. The Vice president IT of Singapore IT stressed the importance of his people going through the conversion experience at US sites:

> *“When the US started their conversion we sent people from here to there to kind of go through their conversion process. We also sent people from the data conversion team to work with the data conversion team and the programmer there for them to explain to us everything about the program and we do everything hands-on there. We go through their live conversion for one of the plants to observe how they do the conversion and what kind of problems they encounter. So that is what we refer to when we talk about the*

transfer of knowledge. Before we do anything we send people there to learn from them. There are Operations people sent there for 2 weeks to sit with their Operations people, and of course the US sites also established some standards, like how the configuration should look like, this is the hardware that we want, this is how we gonna organize the files, the databases and things like that. These are some standards that we will follow. The program changes that we need to follow are also sent. This is one part of the transfer of knowledge: go there, work with them, know, learn from them." - CPW, DiskCo-A-3

Acquiring knowledge from US sites was an example of drift avoidance. The Singaporeans were eager to learn and share available expertise to reduce surprises and possible drift during their own project. The company's schedule was aggressive and had a firm deadline. By June 1999 all systems had to be replaced in order to avoid the risk that corporate systems would stop to function when dealing with year 2000 data (due to the financial year at DiskCo, this would start already in June).

When the conversions commenced in Singapore, people from the US would come over to conduct training and help out. Throughout the project, Singaporeans and Malaysians would call upon their US counterparts for assistance. While the main resources for the implementation were concentrated in Singapore, DiskCo had setup a team for data conversion in Malaysia. People from Singapore and Malaysia tapped into DiskCo US knowledge bases through personal contact and documentation:

"The US sites converted earlier than [Singapore site A]. So they have a lot of people who are more experienced in Oracle. So I work with the US in the sense that if I have any question or issue, or anything that I'm not sure of, I will normally ask them. Because when we have the training session, they do come over and train us, give us some sort of training. So if we have any questions, we are free to ask them." - JLL, DiskCo-G-1

In addition to these personal contacts, the company developed a range of standards, checklists, and other documentation to assist with the conversion. Methods for implementing the software were used to complement the lack of ERP knowledge in Singapore and throughout the DiskCo organization:

"This methodology helps a lot in the sense that because we had never done such an ERP implementation before, not for my self. (…) I think it is quite a structured way, a method, and it really fits very well. I think the method is really derived in such a way that it is a good fit for any organization who wants to do the Oracle ERP implementation." - HHT, Director Applications Development, Singapore site A (DiskCo-B-1)

These efforts show that the company was strongly focused on understanding the unknown in advance. It wanted to avoid drifting and failure at all costs. The Vice president IT in Singapore expressed the pressure he felt which for him translated in highly active involvement in local implementations:

"You can't just sit in your office, waiting for something to happen. Because the impact is so great, when you turn on and it fails, there is no way to go back. And in our conversion, there is no such thing as a parallel run (i.e., running simultaneously the old MANMAN system and new Oracle ERP -

author). It's cut. So when they cut, you move on from one week, there is no way to move back anymore.

Since the consequences are a lot more serious, I cannot just sit there and wait for people to tell me all the good news. I have to be in there to see it. And also an important thing is our conversion schedule is so tight. It's all 24 hours or sometimes 2 days, 2 nights continuously." - CPW, DiskCo-A-3

The project organization took on the properties of a collective effort that attempted to exclude the possibilities of drift. The expectations for local conversions were communicated through a master schedule that spelled out which sites should be converted by which date, including intermediate phases:

"For my role, I have to cover all the plans, make sure that all the plants are converted on time and according to the schedule. For example [Malaysia site A] - all these people there, my director there they have the master plan. They know when it is their turn, and when what they need to do what. We have weekly meeting so that we know when they are supposed to send somebody for what, and when they need to make sure that all the infrastructure is ready. And they also coordinate and work with their local key user to organize training. And if they need any help from here to conduct the training, that is when we have a meeting or even before the meeting they all talk to me very regularly. And then over here (Singapore site A - author) I will coordinate the resources to help them." - CPW, DiskCo-A-3

In combination with DiskCo's hierarchy, the schedule became a visible expression of the organization's required performance. The organizational structure presented people with a de facto set of expectations. Deviations were tolerable nor tolerated as these would jeopardize this important project from succeeding. In conjunction, project failure or success would strenghten or weaken executives responsible for their part of the global ERP project. Careers were on the line:

"You have to have a command hierarchy. And they all know who makes the core, the decision. If you leave it open to anybody to make the core, then there is no way that you can really meet that kind of schedule. Because everybody wants things their way. Everybody wants their convenient time. But we have a kind of structure in such a way that the program is already all laid out, the schedule has to be followed. And in the US the big bosses are all following the schedule very closely. So there is nobody below who can say "Hey I don't want to do it." No. So I think hierarchy is very important. You have a strong support there and it is very clear that that must be done. And it's a "don't ask any questions, just get it done" kind of thing. And then we will draw all the plans nicely to help you to meet that plan. But don't change the schedule. We are the ones who can change or don't change." - CPW, DiskCo-A-5

Operationally, the pressure translated in a tendency to pre-understand and pre-organize local implementations. The company struggled to standardize local operations in line with the EPR system. Understandably, local practices sometimes differed from the principles underpinning the ERP system, sometimes due to public regulations or cultural practices (Soh et al. 2000). People knew this and attempted to highlight, understand, and resolve such differences upfront:

“Of course there are here some quite unique requirements that [Malaysia site A] needed because of some government regulations. So those are already been highlighted quite upfront when they are aware that they need to highlight new and unique features; and then similarly that was done for China. So I would say that there are quite a number of them that is unique because of country requirements” - HHT, DiskCo-B-1

After the first few conversions in Singapore, other Asian sites followed. As Singaporeans had learned from their US counterparts, Asian sites tapped into knowledge accumulated in Singapore. This expertise was communicated in person and reified in documents and checklists that fine-tuned American know-how for the Asian situation.

“During the [Singapore site A] conversion we have gone through so many bad experiences, and good experiences as well, so we know a lot of things, we already know the process very well. So when we come to other sites that they want to convert, we can help them. If you gonna do it this way, you will face this problem, and what is the correct way that they should take. So it shortens a lot of time. Even the conversion table that we set up, they follow us closely. Because if you don't do it, then you face a lot of problems. And also, we have established a lot of reports so when they convert they can just pick up whichever they want. So the time required for them to convert is relatively shorter compared to [Singapore site A].” - JLL, DiskCo-G-1

Throughout the company, people realized the importance of the project. At the start of every implementation, the vice president IT from Singapore would travel to local sites to announce the project. The involvement of this high ranking person in the Far East organization communicated the value of the conversion to DiskCo and it made people listen. When the pressure was put on local sites to contribute for their part to the project, people also received support on how to travel the conversion path.

“Every project before the site starts, we have a kick-off meeting with all the site management and the key users. I'm the one who goes around and does a presentation to them to explain why we need to convert and what are the steps to be carried out to do the conversion. And how the site prepares, and what are the involvements and what is the schedule. And I'm the one who does the communication. And that is the main communication to the manager level. For the key user level, I use the IT person at the site to communicate with them, prepare them, and go through the schedule: when we should bring a PC, upgrade the PC's, when the users should go for training, and how plan according to that.” - CPW, DiskCo-A-5

People from local Asian sites frequently communicated with their counterparts in Singapore who constituted a regional knowledge center. There was a risk that people at local sites would not understand the software or implementation process. Their geographical distance from the Singapore site could lead to a lack of information processing (Allen 1984; Kraut et al. 1990) and early detection of drifting. The satellite site conversions could start drifting and thereby jeopardize the success of the grand project. DiskCo counteracted this risk of drifting by promoting regular visits to local sites. The company was eager to know about unique features of local operations which could grow into deviations from the master plan.

“Sometimes we can talk about one thing, and end up they are doing something else, differently. So it's good that periodically you can visit them and see what is going over there. (…) Some of the countries the people like

China they will follow whatever you say, whatever you have the subsystem they will try to accommodate. But the thing is their operation may be slightly different. But they didn't feedback to you. So if you go there and visit them and you kind of talk to more people, then you get to know more. Then you see that that is not the way they operate. It deviates slightly, and maybe we have to have some workaround for that. If I'm talking about feedback, that is when I go and talk to them during on-site visits. That is the feedback that I gather. So that's why I say it's important to me that I visit them every 3 months or 6 months." - JLL, DiskCo-G-1

Feedback of information from local conversions sustained Singapore's overview of regional progress and confirmed its grip on the project. Regular meetings in person or through teleconferences between for instance China and Singapore clarified local situations and possible deviations from the master schedule. Early detection made small adjustments possible on the move. If local conversions stagnated, Singapore would mobilize resources to help out:

"All of them report back to the same boss (i.e., CPW - author). That is one of the key success factors, because you cut down a lot of unnecessary coordination. And you lead to one dedicated person to make a lot of decisions to make sure that everything is coordinated properly, and to make decisions, and to move the resources to fill the gap. Because all of them now report to one person, all report back to the same organization. The management here can anytime almost randomly move their resources depending on which one is more critical, what is the situation now, how we coordinate that. I think that is very important. If we did not have the free hand to do that, it is very difficult. Because, when the project moves forward, always some things happen, something that you never planned, or something last minute pops up. Like we are doing some hardware, then this factory suddenly ramps up, needs more capacity and things like that. So you have to have the overall person who is able to coordinate all this and also make decisions, and make this call. So it's like: "OK you down to there, drop everything, do this". And I'm not talking about just the application, I'm talking about infrastructure, operation, everything. (…) I think it is important that you have one place, one person to make the call." - CPW, DiskCo-A-3

Knowledge sharing and regular communications thus enabled DiskCo to anticipate and respond to small instances of drifting. The company used Lotus Notes groupware to track and trace small 'projects' that consisted of local requests for adjusting the Oracle system. These requests were carefully monitored because they undermined the idea of implementing one standard software package for the whole corporation. And from a project management point of view, they could delay the implementation. Local sites therefore had to enter their request in the groupware system so that people in Singapore and possibly even the US could monitor almost real time the status and progress.

"We have a very useful project database where we put in our individual enhancement requests. And this is accessible by all plants. From there the local IT approves them and they work on it. So for the programmers, the IT bosses or whoever has access can just view through that and see whether they are working on the right thing. I'm sure they print that status out and

> *review that every week with their own department. But that has to be commented by the IT department. But that database really does help." - ET, DiskCo-K-1*

In short, DiskCo Singapore attempted to make the regional ERP implementation a success. They invested in knowledge transfer from the US to Singapore and methods for successful implementations. They refined that knowledge and passed it on to other regional sites. The Singapore site passed on the pressure of project success according to the global master schedule to local sites while informing and equipping them for the job they had to accomplish. These efforts translated in a very active organization that processed relevant signals for project progress aggressively. Small adjustments were made to cater for deviations between the planned conversion and actual experience. Despite this strong drive to avoid and reduce drifting, the project did start to drift on some occasions. How the company dealt with these situations is presented in the next paragraph.

Sideslips and back to control

In areas with snow or heavy rain, car drivers know the risk of sideslips. Most people will drive very carefully. They concentrate on the surface condition, they monitor other drivers. In advance they may prepare extensively by watching weather broadcasts and selecting the least risky route, supposed they have to get out. They attempt to avoid skidding by investing in ex ante expertise and executing pre-orchestrated moves.

These practices resemble DiskCo's focus on and investments in avoiding drift. As practice tells, however, sometimes even the best prepared and experienced drivers may experience sideslips. DiskCo Singapore, with all its investments in various forms of knowledge management, and extensive interpersonal communications practices encountered sideslip experiences on more than one occasion. Small deviations were resolved by sending in more resources, and working sometimes through the night and evening:

> *"When we have a weekly meeting it is a meeting conference call. That means all the sites that are involved in the project, we have a weekly meeting, conference call and each of the sites will report their status. What are the preparations they, are in and individually I will also talk to the director of my IT organization over there, to track where they are. What we have is, for example this is [Singapore site A], then this is say [Malaysia plant A]. We know that from [Singapore site A] to [Malaysia plant A] we have 2 months. And we also know exactly which week we are doing the trial data load, CRP, the business test, user training etc. We track this very closely to make sure that all this is on time. If any of these things slip it is potentially affecting other sites." - CPW, DiskCo-A-3*

Some sideslips could not be resolved by piecemeal adjustments. People would encounter challenges that could not be resolved within the context of the original project structure. One way of responding is by not accepting the situation and enhancing control, i.e., further increasing the pressure on people. This would fit the first approach towards drift. If reality doesn't match the control structure, it should be forced to fit. A driver would not accept his experience. Unfortunately, such attempts to counteract reality often lead to out of control situations. The car will spin away and most likely come to an unpleasant stop. With IS projects, the potential consequence of this idea is escalation, as people are not granted the time they need to resolve issues, and increasingly resist the pressure put on them.

Another response would be acceptance of drift (the second approach). People would acknowledge the inherent difficulty of implementing standardized software in a heterogeneous organization. Most organizations cannot accept this approach as too many interests are on the line. When managers cannot predict whether and how they will arrive at the preset deadline, they lose credibility.

In our driving example, the third approach would imply that the driver accepts his condition of drifting but looks for feasible interventions that will somehow lead him back to control. We found evidence that this third approach to drifting works in practice. DiskCo Singapore experienced three major drift situations. These can be defined as moments when people cannot possibly meet project milestones. The reason is local practice differs substantially from what they initially expected. The mismatch with the new system becomes so severe that pre-knowledge and plans cannot cater for it.

In short, DiskCo responded to these major drift situations by (1) pausing the complete project, (2) letting people sort out and understand the problem, and (3) accelerating the project afterwards fueled by the newly acquired knowledge. Metaphorically, one could imagine a driver starting to skid, and responding by taking time to perform counter moves, and then once he has regained control, he continues with renewed confidence.

DiskCo's Singapore conversion drifted when the project team attempted to let the system process the huge volumes of the manufacturing plant there.

> *"After [Singapore site A], (...) is supposed to convert another big plant, but ever since [Singapore site A] converted, we are having a lot of system issues because that is only the time when you see the real volume coming. During the test you cannot really do a so-called stress test to the real environment. And we have a lot of other things, also because we are in the learning stage of the learning curve. A lot of things we don't understand well, we have to take much longer. So after the conversion of Singapore site A we suffer a lot - about 3 months before we stabilize." - CPW, DiskCo-A-3*

DiskCo US had implemented the ERP system in a smaller scale R&D operation. Their expertise and checklists were geared to that situation and insufficient for the Asian plants that manufactured massive volumes for the world market. Not only did the American practices not meet requirements in Asia, US experts could not identify with the situation in Singapore as they were used to R&D operations.

> *"Because Singapore site A is a main manufacturing firm, we have huge volumes. To them (US - author) it is mainly for R&D. So usually when we have some issues, they will not see the problem. Usually IT (from US - author) will say: "How come Singapore site A you have that issue?" The volume is different, we have a higher volume. There is a difference here, but they will not really see our problem. Because sometimes there are some system problems, their sites do not have the problem, but our site has the problem." - ST, DiskCo-H-1*

The vice president IT learned from his conversion team there were major problems with the first implementation. This initial setup of the ERP system was not stable, meaning that it could not process the real volumes common to Asian disk drive plants. Instead of sticking to the original schedule, the VP urged his boss not to proceed according to the original schedule. Instability at the first plants would infect subsequent implementations.

“The initial plan is that next month we convert another plant. So I tell my boss no. That will just be a disaster. Because we believe that Singapore site A must be stabilized. Anything we do at [Singapore site A] we apply the same to rest of the drive plants. If we cannot stabilize here and we continue to apply, then every plant will fail. And I cannot afford to fail one plant and focus all my resources just to solve all the problems. I cannot afford to stretch my resources to solve problems of a few plants happening in the same time span. So we adjust that and we had a lot of good reasons to convince the boss to adjust. (…) And that is one of my roles, to look at the situation and adjust the plan and convince the management that we need to adjust the plan. And the people below are the ones who keep enough detail and feedback and say: “Hey we cannot make it”. I have to make that call and decide either to pull in more resources or adjust the plan.” - CPW, DiskCo-A-3

People realized that the project was drifting as phase progress came to a stop in Singapore. During this period, however, rapid progress was made in terms of building expertise. In the process, people communicated extensively locally and with US counterparts to learn how to deal with the huge volumes. Once they understood, the implementation continued the prescribed phases of the master schedule but not at the same pace with a few months of delay. The know-how in Singapore enabled acceleration compared to the original schedule. After a phase of drifting, DiskCo had regained control of the project at a higher level.

“We made 3 major adjustments. That means after the [Singapore site A] conversion, we were supposed to convert another Malaysian site one month later. But after [Singapore site A] conversion the system was not stable, we had a lot of problems. And the resources that we have are just good enough to solve our [Singapore site A] problems. Since the rest of the Drive plants were all depending on whatever modification we have for [Singapore site A], and wait for this system to stabilize, we think that we should push up the rest for 2 months. And that is a good decision because after 2 months we cleared all the issues here. Then when we (team from Singapore site A - author) go over there, the conversion only takes 2 days. Because all the issues were resolved.” - CPW, DiskCo-A-5

To conclude, DiskCo knew it run the risk of drifting and it did everything to avoid it. While smaller instances of drifting could be handled by increasing pressure on the organization (more resources, longer working hours), the company released the pressure in case of serious side slipping. This provided the project team with space to drift and acquire knowledge with a focus in mind. Once these issues were resolved, the company reconsidered its original structure, looking for opportunities to leverage the drifting episode in terms of acceleration, knowledge sharing, and increased grip on future implementations.

Implications for Research

With the limitations of this study in mind, we can now point at our contribution and connections to literature. Our limitations are, first, the focus on projects, not the organizational level. Second, the single case study method supports theory building and conceptual generalization, but cannot offer statistical generalization obtained with quantitative methods (Yin 1994). And third, our focus on packaged software implementation implies that we cannot make claims about multi-site implementation of custom-built software, or IS development projects.

The DiskCo case suggests that drift in multi-site ERP implementations can be contained and used beneficially. Initially, the Far East sites eagerly attempted to avoid drifting by such practices as promoting learning and using shared documentation. These practices enabled recovery from minor glitches during the implementation. Glitches can be defined then as situations where existing procedures and knowledge appear inadequate but do not necessitate deviation from the original project plan. During these events, the company sticked to its original control strategy and simply invested more resources to resolve the problem.

On a few occasions, however, the project truly started to drift. According to our definition of drifting, this means that unexpected circumstances were encountered that showed the incompleteness and possible failure of an initial operating modus without the organization having yet feasible alternatives. DiskCo responded with three steps.

- First, the company stopped the overall project to avoid unnecessary resources consumption, and continuation of the project without working solutions.
- Second, the organization developed a dual focus. On one hand, it stayed tuned to the overarching goal of achieving the main project objective: implementing the system before the Y2K could disrupt the current systems. On the other hand, the organization worked on addressing the sources of drifting. This dual attention differs from the control and incremental strategy. With the control strategy, an organization remains focused on the tight alignment of overarching objectives, plans, and operations. Deviation in the operations are top-down suppressed or eliminated. The incremental strategy suggests that the overarching objective would shift along with the operational drift.

  Our case study suggests that the third strategy offers a viable alternative. Drifting is not necessarily a reason for changing the overarching objective. The organization remains focused on the final objective, and makes adjustments necessary for achieving it. Similarly, a driver starting to skid on a wet surface divides his attention between the overarching goal of not hitting anyone or anything, while performing the specific movements necessary to address the skidding car. A control strategy would imply an attempt to maintain control using the original routines which do not work under these circumstances. An incremental strategy means that the driver becomes so locked up in resolving the micro problem that he loses sight of the larger context in which he operates. Weick and Roberts (1993) give examples of this phenomenon on aircraft carriers where pilots become locked up in aircraft malfunctioning and forget their embeddedness in the larger airspace and air control activity system.
- Third and finally, once the sources of drifting are understood and resolved, the original control strategy kicks in though with a twist. Knowledge acquired during the drift resolution phase is used for accelerating the project phases to make up for time lost and achieve the project objective.

We connect these findings to the wider literature relevant to drifting and adaptation. First, our findings lead to reinterpretation of failure cases. In Holmström and Stadler (2001) case, the initial failure of the Swedish cash card implementation was caused by the banks ignoring of critical comments from the environment. The banks were incapable of or unwilling to stay focused on the overarching objective – introducing an advanced payment system – while allowing for operational deviations to meet stakeholder expectations. Their rigid control strategy estranged them from the societal context, which increased resistance.

Second, our findings suggest new insights in the ostensive (idea) – performative (execution) adaptation cycle introduced by (Feldman et al. 2003). Minor glitches in the execution of a program may lead to variation without changing the original plan and the idea behind a routine. Major disruption, however, shifts attention temporarily from program execution towards learning. The overall idea remains intact, while the planning may be changed to allow for ad hoc learning. This results – in addition to pragmatic problem solving – in new ostensive insights.

Finally, the case study contributes to literature on crisis management, where crisis is defined as any event or condition that threatens the survival of the organization (D'Aveni et al. 1990). Current literature suggests that in case of crisis, successful managers tend to focus on their environment, while unsuccessful managers devote their time to internal problems (D'Aveni et al. 1990). Our research extends this internal versus external focus debate. We found that successful response to drifting implies a dual focus on the organizational objective and resolving operational sources of drifting. In the DiskCo case, people – not only managers – remained focused on the overall objective, partly because bonuses were tied to intermediate milestones and the end result.

Implications for Practice

Our study offers pointers for management. Organizations implementing packaged software are likely to experience drifting. While the phenomenon might be inevitable to some extent, organizational response to drifting seems to explain success or failure. Successful organizations define the overarching goal in advance. The definition must be sufficiently relevant and abstract that under different conditions it can serve as a beacon. Once translated into specific plans and procedures, drifting may occur but does not necessarily lead to loss of control. The level of control becomes more abstract as organizations focus on the overall objective. Simultaneously, resources must be invested towards accelerating resolution of drifting. While challenging, managers should not panic when drifting occurs. They must steer clear of rigid enforcement of the original straightjacket (control strategy). They must also not let the situation overwhelm them and pull them into an incremental strategy mode. This may lead to unnecessary and undesirable adaptation of the overall objectives, resulting in extended drifting experience. Drift is more likely to occur and to lead to failure when managers exhibit behaviors that support these two dysfunctional directions.

Drift-resolving managers will display the courage and master the art of keeping sufficient distance from the situation to remain calm and focused on the overall goal, while staying closely involved to support their organization in its attempt to resolve the drifting. At the end of the drifting episode, they can push people to share and apply their lessons learnt in order to make up for the lost time. Their focus has always been on accomplishing the overarching objective.

Conclusion

Drifting is a phenomenon that seems inevitable in IS implementation, particularly in complex ERP systems projects. The objective of this conceptual and empirical paper has been twofold. The first is to gain a better insight into the origins and nature of drifting. We reviewed recent research on IS implementation in general and on ERP systems implementation more specifically. The second aim was to show how organizations deal with drifting in a contained manner in the sense of regaining control instead of letting projects escalate. Literature proposes three strategies to deal with drifting: control, incremental, and drift containment. We discussed background and nature of each approach, and continued to focus on the third strategy which seemed most promising. We empirically investigated how drift containment could be accomplished in practice in a multi-site ERP implementation project. Our results suggest that organizations must first recognize when drifting occurs. Next, they must differentiate between a project’s overarching objectives – which remain relatively stable – and their operational drifting experiences. While staying focused on the objectives, they address the causes of drifting. Finally, lessons learnt during drifting resolution must be shared and applied to accelerate materialization of project objectives.

References

Allen, T.J. *Managing the flow of technology* MIT Press, Cambridge, MA, 1984.

Alvarez, R., and Urla, J. "Tell Me a Good Story: Using Narrative Analysis to Examine Information Requirements Interviews during an ERP Implementation," *ACM SIGMIS Database* (33:1) 2002, pp 38-52.

Attewell, P. "Technology diffusion and organizational learning: the case of business computing," *Organization Science* (3:1) 1992, pp 1-19.

Bauer, M. "'Technophobia': A Misleading Conception," in: *Resistance to New Technology,* M. Bauer (ed.), Cambridge University Press, Cambridge (UK), 1995.

Beniger, J.R. *The Control Revolution* Harvard University Press, Cambridge, MA, 1986.

Borton, J.M., and Brancheau, J.C. "Does effective information technology implementation process guarantuee success?," Proceedings of the IFIP TC8 working conference on diffusion, transfer and implementation of information technology, Pittsburgh, 1993.

Bradford, M., and Florin, J. "Examining the role of innovatioin diffusion factors on the implementation of enterprise resource planning systems," *International Journal of Accounting Information Systems* (4) 2003, pp 205-255.

Ciborra, C.U. "A theory of Information systems based on improvisation," in: *Rethinking Management Information Systems: An Interdisciplinary Perspective,* W.L. Currie and B. Galliers (eds.), Oxford University Press, Oxford, 1999, pp. 136-155.

Ciborra, C.U. *The Labyrinths of Information. Challeging the Wisdom of Systems* Oxford University Press, Oxford, 2002.

Ciborra, C.U., Braa, K., Cordella, A., Dahlbom, B., Failla, A., Hanseth, O., Hepso, V., Ljungberg, J., Monteiro, E., and Simon, K.A. *From control to drift. The dynamics of corporate information infrastructure* Oxford University Press, Oxford, 2001a.

Ciborra, C.U., and Hanseth, O. "Introduction," in: *From control to drift. The dynamics of corporate information infrastructure*, C.U. Ciborra, K. Braa, A. Cordella, B. Dahlbom, A. Failla, O. Hanseth, V. Hepso, J. Ljungberg, E. Monteiro and K.A. Simon (eds.), Oxford University Press, Oxford, 2001b.

D'Aveni, R.A., and MacMillan, I.C. "Crisis and the Content of Managerial Communications: A Study of the Focus of Attention of Managers in Surviving and Failing Firms," *Administrative Science Quarterly* (35:4) 1990, pp 634-657.

Davenport, T.H. "Putting the Enterprise into the Enterprise System," *Harvard Business Review*:July-August) 1998, pp 121-131.

Davis, F.D. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* (13:3) 1989, pp 319-340.

Davis, F.D., Bagozzi, P., and Warshaw, P.R. "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models," *Management Science* (35:8) 1989, pp 982-1003.

De Wit, B., and Meyer, R. *Strategy. Process, Content, Context. An International Perspective* West Publishing Company, New York, 1994.

Edmondson, A.C., Bohmer, R.M., and Pisano, G.P. "Disrupted routines: Team learning and new technology implementation in hospitals," *Administrative Science Quarterly* (46:4) 2001.

Eisenhardt, K.M. "Building Theories from Case Study Research," *Academy of Management Review* (14:4) 1989, pp 532-550.

Esteves-Sousa, J., and Pastor-Collado, J. "Enterprise Resources Planning Systems Research: an annotated bibliography," *Communications of the Association for Information Systems* (7:8) 2001, pp 1-51.

Feldman, M.S. "Organizational routines as a source of continuous change," *Organization Science* (11:6) 2000, pp 611-629.

Feldman, M.S., and Pentland, B.T. "Reconceptualizing Organizational Routines as a Source of Flexibility and Change," *Administrative Science Quarterly* (48:1), September, 2002 2003, pp 94-118.

Gibbons, M., Nowotny, H., Limoges, C., Schwartzman, S., Scott, P., and Trow, M. *The new production of knowledge: the dynamics of science and research in contemporary societies* Sage, London, 1994.

Giddens, A. *The Constitution of Society: Outline of the Theory of Structuration* University of California Press, Berkeley, CA, 1986.

Giddens, A. *The consequences of modernity* Polity Press, Cambridge, 1991.

Grabski, S.V., Leech, S.A., and Lu, B. "Enterprise System Implementation Risks and Controls," in: *Second-Wave Enterprise Resource Planning Systems : Implementing for Effectiveness*, G. Shanks, P.B. Seddon and L.P. Willcocks (eds.), Cambridge University Press, Cambridge (UK), 2003.

Gunther McGrath, R. "Exploratory learning, innovative capacity and managerial oversight," *Academy of Management Journal* (44:1) 2001, pp 118-131.

Hanseth, O., and Braa, K. "Who's in control: Designers, Managers - or Technology? Infrastructures and Norsk Hydro," in: *From control to drift. The dynamics of corporate information infrastructure*, C.U. Ciborra, K. Braa, A. Cordella, B. Dahlbom, A. Failla, O. Hanseth, V. Hepso, J. Ljungberg, E. Monteiro and K.A. Simon (eds.), Oxford University Press, Oxford, 2001, pp. 125-147.

Hanseth, O., and Monteiro, E. *Understanding Information Infrastructure*, Available at: http://heim.ifi.uio.no/~oleha/Publications/, Forthcoming.

Hirschhorn, L. *Beyond Mechanization: Work and Technology in a Postindustrial Age* MIT Press, Cambridge, MA, 1984.

Holland, C.P., and Light, B. "A framework for understanding success and failure in Enterprise Resource Planning System implementation," in: *Second-Wave Enterprise Resource Planning Systems : Implementing for Effectiveness*, G. Shanks, P.B. Seddon and L.P. Willcocks (eds.), Cambridge University Press, Cambridge (UK), 2003, pp. 180-195.

Holmström, J., and Stadler, F. "Drifting technologies and multi-purpose networks: the case of the Swedish cash card," *Information and organization* (11:3) 2001, pp 187-206.

Jones, M. "Structuration Theory," in: *Rethinking Management Information Systems*, W.L. Currie and B. Galliers (eds.), Oxford University Press, Oxford, 1999, pp. 103-135.

Keil, M. "Pulling the plug: Software project management and the problem of project escalation," *Mis Quarterly* (19:4), Dec 1995, pp 421-447.

Kirsch, L.J. "The management of complex tasks in organizations: Controlling the systems development process," *Organization Science* (7:1) 1996, pp 1-21.

Klein, H.K., and Myers, M.D. "A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems," *MIS Quarterly* (23:1) 1999, pp 67-94.

Kraut, R.E., and Galegher, J. "Patterns of contact and communication in scientific research collaboration," in: *Intellectual Teamwork: Social and Technological Foundations of Cooperative Work*, J. Galegher, R.E. Kraut and C. Egido (eds.), Lawrence Erlbaum Associates, Hillsdale, New Jersey, 1990.

Lyytinen, K.J. "A Taxonomic Perspective of Information Systems Development: Theoretical Constructs and Recommendations," in: *Critical Issues in Information Systems Research,* R.J. Boland and R.A. Hirschheim (eds.), Wiley, New York, 1987, pp. 19-37.

Markus, M.L., and Petrie, D. "Continuity Versus Discontinuity: Weighing the Future of ERP Packages," in: *Second-Wave Enterprise Resource Planning Systems. Impementing for Effectiveness,* G. Shanks, P.B. Seddon and L.P. Willcocks (eds.), Cambridge University Press, Cambridge (UK), 2003, pp. 419-440.

Markus, M.L., Tanis, C., and van Fenema, P.C. "Multisite ERP Implementations," *Communications of the ACM* (43:4) 2000.

Miles, I., and Thomas, G. "User Resistance to New Interactive Media: Participation, Processes, and Paradigms," in: *Resistance to New Technology,* M. Bauer (ed.), Cambridge University Press, Cambridge (UK), 1995.

Miles, M.B., and Huberman, A.M. *Qualitative Data Analysis: An Expanded Sourcebook*, (2nd ed.) Sage, Thousand Oaks, CA, 1994.

Mill, J.S. *System of Logic* University of Toronto Press, Toronto, 1987.

Monteiro, E. "Actor-Network theory and infromation infrastructure," in: *From control to drift. The dynamics of corporate information infrastructure*, C.U. Ciborra, K. Braa, A. Cordella, B. Dahlbom, A. Failla, O. Hanseth, V. Hepso, J. Ljungberg, E. Monteiro and K.A. Simon (eds.), Oxford University Press, Oxford, 2001, pp. 71-83.

Motwani, J., and Mirchandani, D. "Successful Implementation of ERP Projects: Evidence from Two Case Studies," *International Journal of Production Economics* (75) 2002, pp 83-96.

Myers, M.D. ""Qualitative Research in Information Systems", MIS Quarterly (21:2), June 1997, pp. 241-242. MISQ Discovery, archival version, June 1997, http://www.misq.org/misqd961/isworld/. MISQ Discovery, updated version, last modified: September 15, 2003 http://www.qual.auckland.ac.nz/," 2001/ 2003.

Nonaka, I. "A Dynamic Theory of Organizational Knowledge Creation," *Organization Science* (5) 1994, pp 14-37.

Orlikowski, W., and Robey, D. "Information technology and the structuring of organizations," *Information Systems Research* (2:2) 1991, pp 143-169.

Orlikowski, W.J. "The Duality of Technology: Rethinking the Concept of Technology in Organizations," *Organization Science* (3:3) 1992, pp 398-427.

Orlikowski, W.J., and Gash, D.C. "Technological Frames: making sense of information technology in organizations," *ACM Transactions on Information Systems* (12:2) 1994, pp 174-207.

Räisänen, C., and Linde, A. "Technologizing Discourse to Standardize Projects in Multi-Project Organizations," *Organization* (11:1) 2004, pp 101-121.

Rogers, E.M. *Diffusion of innovations* Free Press, New York, 1995.

Rosenberg, N. *Inside the Black Box: Technology and Economics* Cambridge University Press, Cambridge (UK), 1982.

Sauer, C. "Deciding the Future for IS Failures: Not the Choice You Might Think," in: *Rethinking Management Information Systems,* W.L. Currie and B. Galliers (eds.), Oxford University Press, Oxford, 1999, pp. 279-309.

Schwartz Cowan, R. "The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology," in: *The Social Construction of Technological Systems. New Directions in the Sociology and History of Technology,* W.E. Bijker, Pinch, T.J., & Hughes,T.P. (Eds.) (ed.), MIT Press, London, 1990, pp. 261-280.

Scott, J., and Vessey, I. "Implementing Enterprise Resource Planning Systems: the role of learning from failure," in: *Second-Wave Enterprise Resource Planning Systems : Implementing for Effectiveness,* G. Shanks, P.B. Seddon and L.P. Willcocks (eds.), Cambridge University Press, Cambridge (UK), 2003, pp. 241-274.

Sia, S.K., Tang, M., Soh, C., and Boh, W.F. "Enterprise Resource Planning (ERP) Systems as a Technology of Power: Empowerment or Panoptic Control?," *Database for Advances in Information Systems* (33:1) 2002, pp 23-37.

Snook, S.A. *Friendly Fire: The Accidental Shootdown of U.S. Black Hawks over Northern Iraq* Princeton University Press, Princeton, NJ, 2000.

Soh, C., Kien, S.S., and Tay-Yap, J. "Cultural Fits and Misfits: Is ERP a Universal Solution?," *Communications of the ACM* (43:4) 2000, pp 47-51.

Strong, D., Volkoff, O., and Elmes, M.B. "ERP Systems and the Paradox of Control," Ninth Americas Conference on Information Systems, Tampa, FL, 2003.

Tyre, M.J., and von Hippel, E. "The Situated Nature of Adaptive Learning in Organizations," *Organization Science* (8:1) 1997, pp 71-83.

van Dissel, H.G. *Information planning in cycles: toward alternative perspectives on information planning* Eburon, Delft, 1999.

Waarts, E., van Everdingen, Y.M., and van Hillegersberg, J. "The dynamics of factors affecting the adoption of innovations," *The Journal of Product Innovation Management* (19) 2002, pp 412-423.

Walsham, G. "Cross-cultural Software Production and Use: A Structuration Analysis," *MIS Quarterly* (26:4) 2002, pp 359-380.

Weick, K.E., and Roberts, K. "Collective Mind in Organizations: Heedful Interrelating on Flight Decks," *Administrative Science Quarterly* (38) 1993, pp 357-381.

Winner, L. *Autonomous Technology. Technics-out-of-Control as a Theme in Political Thought* MIT Press, London, 1977.

Yin, R.K. *Case Study Research: Design and Methods* Sage, Newbury Park, CA, 1994.

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