

# The Journal of the Southern Association for Information Systems

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Volume 6 | Issue 1

Article 1

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March 2020

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### Recommended Citation

Yayla, Alper and Lei, Yu (2020) "Information Technology Implementation and Organizational Change: A Dissipative Structure Theoretical Lens," *The Journal of the Southern Association for Information Systems*: Vol. 6 : Iss. 1 , Article 1.

Available at: <https://aisel.aisnet.org/jsais/vol6/iss1/1>

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# INFORMATION TECHNOLOGY IMPLEMENTATION AND ORGANIZATIONAL CHANGE: A DISSIPATIVE STRUCTURE THEORETICAL LENS

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## ABSTRACT

Previous research on information technology (IT) implementation and organizational change postulates that neither technology nor human agency determines the new structure of the organization, but rather the new structure emerges as a result of the interplay between technology and human agency. A majority of these studies assume a linear relationship between contingencies and outcome during the emergence process. However, during the implementation process, the characteristics of organizations become non-linear, almost chaotic. Therefore, we postulate that approaching to IT-enabled change from complexity theory would be better suited to explain the emergence process. We propose a framework based on dissipative structure theory and specify four stages that organizations undergo during the implementation process. While the emergence process is considered unpredictable, we argue that with the help of certain organizational practices (i.e., organizational learning/unlearning) and managerial interventions (i.e., use of rhetoric), organizations can condition the emergence of the new structure for the success of the implementation.

## Keywords

IT implementation; Organizational change; Dissipative structures; Complexity theory; Organizational learning; Rhetoric

## INTRODUCTION

As a long-studied and well-established area, adoption of information technology has been examined extensively in the information systems (IS) literature. One of the main research streams in this literature focuses on organizations' decision to adopt and assimilate a particular innovation (Bui, 2015). According to the findings of the extant studies, after getting the initial knowledge of an innovation and forming positive attitudes towards it, decision-makers in organizations decide to adopt the innovation, which leads to implementation and final confirmation of the decision (Rogers, 1995). Due to its embeddedness in organizational structure, adopting a large-scale information technology (IT) brings change to organizations. However, organizations feel the effect of the change on their structure when the innovation is put to use during the implementation stage since, before implementation, innovation is just a decision choice or a mental exercise for the decision maker (Rogers, 1995).

Despite the continuously evolving research, the interplay between the structure of an organization and the implementation process has been under-investigated (Tidd and Bessant, 2011), yet gaining more traction in the past decade (Bloom, Garicano, Sadun, Reenen, Van Bloom and Garicano, 2014; Leonardi and Barley, 2010; Nan, 2011). One of the significant findings of this particular literature is that implementing the same technology in similar organizations can lead to the formation of different structures across these organizations (e.g., Barley, 1986; Edmondson, Bohmer, Pisano, 2001; Robey and Sahay, 1996). This finding indicates that the emergence of new organizational structure as a result of IT implementation is neither completely depended on human agency nor driven by technological determinism but rather socially constructed (Edmondson et al., 2001; Robey and Sahay, 1996). Considering this, recent studies took the view that balances technological determinism and human agency, mostly by utilizing Giddens's (1984) structuration theory to examine the emergence process (e.g., DeSanctis and Poole, 1994; Majchrzak, Rice, Malhotra, King, Ba, 2000; Orlikowski, 1992). While studies moved

from a static view to a dynamic view of IT-enabled change as the literature matured, most of them still assumed a linear relationship between antecedents and outcome or between individual level and collective level use (Nan, 2011).

Given that organizations experience uncertainty, complexity, and disorder during the change process (Gemmill and Smith, 1985), this process should be considered almost chaotic rather than linear. A linear assumption overlooks the complexity inherent in the change process (Merali, Papadopoulos, Nadkarni, 2012). To overcome the limitations of linear approaches, recent studies examined organizational change from the complexity theory perspective (Chiles, Meyer, Hench, 2004; McBride, 2005; Nan, 2011). Since the emergence process plays a central role in complexity theory, it is ideally suited to provide another level of granularity to understand this organizational phenomenon (Chiles et al., 2004).

Complexity theory emphasizes the unpredictability of the emergence process. That is, IT implementation may lead to the emergence of an organizational structure neither ideal nor targeted. We posit that the emergence process during IT implementation can be *conditioned* through negative feedback in the form of managerial interventions (i.e., rhetoric) and organizational processes (i.e., organizational learning). A conditioned emergence gives the organization a better chance to reach a targeted structure, increasing the success of the implementation process.

The main goal of this paper is to provide a framework that captures the emergence of new organizational structure as a result of IT implementation. Our proposed framework is based on dissipative structure theory, which has its roots in complexity theory. Using dissipative structure theory provides several benefits since it considers both positive and negative feedback to the system and highlights the importance of continuous energy inflow to and outflow from the system. Based on our framework, we provide a detailed discussion of the change process as organizations progress through IT implementation parallel to the stages of a dissipative structure. We postulate that, in each stage, organizations face a different type of inertia as a positive feedback that needs to be countered with an apposite negative feedback to condition the emergence for the success of the implementation.

#### **IT IMPLEMENTATION AND ORGANIZATIONAL CHANGE**

The adoption of IT innovations by organizations has two main stages (DeSanctis and Poole, 1994; Finchman, 2000; Finchman and Kemerer, 1999): decision to adopt the innovation and implementation of the innovation. Studies that examine the *decision stage* focus on how decision-makers are exposed to the innovation initially, how they form their attitude towards the innovation, and how they finalize their decision to adopt or reject the innovation (e.g.; Brancheau and Wetherbe, 1990; Lai and Mahapatra, 1997; Moore and Benbasat, 1991; Prekumar, Ramamurthy, Nilakanta, 1994; Rogers, 1995). Studies that examine the *implementation stage* traditionally focus on the factors that affect the use and acceptance of the innovation by the targeted users, yet some of the recent studies differentiate the initial use during implementation from the continuance of use after adoption of the innovation (e.g., Ajzen, 1988; Davis, Bagozzi, Warshaw, 1989; Davis, 1989; Leonard-Barton and Deschamps 1988). Figure 1 presents a summary of various approaches to adoption of innovations.

The recent research on IT implementation suggests that interactions of humans with each other and their environment need to be broken down and examined either individually or collectively. For instance, Angst, Agarwal, and Sambamurthy (2010) postulate that IT diffusion can be viewed as a social contagion process in which information is transmitted through interactions between adopters and non-adopters. Similarly, Hargrave and Van de Ven (2006) highlight the political behavior and collective action in organizations to promote institutional innovation. Moreover, other studies show that ideology, framing, and motivation of individuals affect the adoption process as well (Barrett, Heracleous, Walsham, 2013; Kennedy and Fiss, 2009). These findings point to the importance of investigating behaviors at the individual level, which collectively influence the adoption of innovations at the organizational level and the overall change process in the organization.

However, this view does not suggest that scholars should focus on only “parts” instead of the “whole,” but rather, it suggests that we should rethink the connection between individual behavior and collective behavior. Individual level adoption of innovation does not necessarily guarantee organizational level adoption, and similarly, deeply diffused innovation within an organization does not necessarily mean that every individual understands and

realizes the benefits of that innovation. Moreover, successful implementation requires the continuous use of the technology at the individual level and routinization of the new workflows based on the new technology at the organizational level (Brancheau and Wetherbe, 1990; Lapointe and Rivard, 2007).

	<b>Period A Initiation</b>			<b>Period B Implementation</b>			<b>Period C Post-Adoption</b>	
<i>Lewin's (1952) change model</i>	Unfreeze			Change			Freeze	
<b>Stages of adoption models</b>								
<i>Thompson (1969)</i>	Initiate			Adopt	Implement			
<i>Rogers (1995)</i>	Knowledge	Persuasion	Decision	Implementation			Confirmation	
<i>Kwon and Zmud (1987)</i>	Initiation			Adoption	Adaptation	Acceptance	Use	Incorporation
<i>Leonard- Barton (1988)</i>	Decision			Implementation				

**Figure 1. Different approaches to the adoption of IT innovations by organizations**

The creation of these new routines leads to change in organizations. The level of change, however, depends on the extent and embeddedness of the IT innovation. Organizational change causes differences in “how an organization functions, who its members and leader are, what form it takes, or how it allocates its resources” (Huber, Sutcliffe, Miller, Glick, 1993, p. 216). Change can be a result of a planned event (e.g., installation of an enterprise system) or an unplanned event (e.g., labor strike). A majority of organizational change studies take the evolutionary perspective and argue that the rate of change is either gradual or episodic (Burke, 2013; Weick and Quinn, 1999). Gradual change assumes continuous change – change that is ongoing, evolving, and cumulative (Weick and Quinn, 1999). On the other hand, episodic change considers long periods of minimal change punctuated by a revolutionary period of change – change that is infrequent, discontinuous, and intentional (Weick and Quinn, 1999).

However, organizations tend to be structurally inert and slow to change (Aldrich, 1999) as they dampen the effects of change with their inertia (Hannan and Freeman, 1977). Organizational inertia arises from internal arrangements (i.e., organizational history, politics and power, certain investments) and from the environment (i.e., legal barriers, fiscal barriers, and legitimacy) (Hannan and Freeman, 1977). Traditionally, organizational routines have been considered as sources of stability and inertia as well (Howard-Grenville, 2005; Yi, Knudsen, Becker, 2016).

Implementation of organization-wide IT has the potential to break the existing inertia given its effect on routines. However, implementation of IT cannot bring the change itself (Markus, 1983). When existing routines are heavily embedded in the organizational structure, change may require mobilization of resources (Howard-Grenville, 2005). In addition to resource mobilization, a shift in collective cognitive and shared interpretive schemes may be necessary to overcome the inertia (Balogun, Jacobs, Jarzabkowski, Mantere, Vaara, 2014; Mezias, Grinyer, Guth, 2001). Therefore, managerial support and commitment are essential for the success of the implementation (Klein, Conn, Sorra, 2001; Leonard-Barton and Deschamps, 1988; Repenning, 2002).

## DISSIPATIVE STRUCTURE THEORY AND IT-ENABLED CHANGE

While early applications of complexity theory were for systems in nature, a growing body of literature in the organizational studies is using the complexity theory lens to study various organizational phenomenon. Complexity theory focuses on emergence of order in dynamic non-linear systems at the edge of chaos (Burnes, 2005). Emergence can explain how changes in micro levels can lead to changes in macro level and lead to actual structure formation (Onik, Fielt, Gable, 2016; Salem, 2013). While emergent systems can be defined as the behavior of a system as a result of the interactions of its parts (Lissack, 1999), emergent systems are not reducible to their parts (Demetis and Lee, 2016; Lichtenstein, 2000a; MacLean and MacIntosh, 2003). Moreover, emergent systems consider both positive feedback (forces towards instability) and negative feedback (forces towards stability) (Houchin and MacLean, 2005; Stacey, 1995), causing non-linearity. Due to this non-linearity, in emergent systems, even small changes can have big impacts and lead to different outcomes, which makes the initial conditions of the system important (Anderson, 1999; Stacey, 1995). Consequently, in such systems, these characteristics lead to the *emergence* of a new structure rather than reaching to an intended end result.

Parallel to the systems in nature, organizational systems show similar emergent behaviors. For instance, when organizational members interact with each other, the effect is non-linear (Lichtenstein, 2000a; Stacey, 1995). One person's action affects the other and the other reacts in a way that affects the first person. That is, the consequence of an action becomes a feedback and affect the person initiating the action. Similarly, when a change occurs, some organizational members will support the change, creating negative feedback, and others will oppose the change, creating positive feedback. Yet, group behavior in organizations are not simply the sum of individual behavior (Stacey, 1995). Moreover, existing characteristics of the organization such as rules, systems, and roles create the initial conditions, making the emergence process unique for each organization.

Overall, compared to traditional linear approaches, complexity theory provides an opportunity to understand the nuances of the emergence process (Lichtenstein, 1995). While there are many competing views that study emergence in complexity theory, there are three key perspectives: complex adaptive systems, chaos theory, and dissipative structure theory (Burnes, 2005). Complex adaptive systems seek emergence on a micro level and emergence occurs as the result of behaviors of semiautonomous agents following a limited number of simple rules (Burnes, 2005; Lichtenstein, 2000b). Complex adaptive systems do not consider organizations as entities that are driven with a structural form and a certain level of determinism but rather as systems with a bottom-up approach based on a collection of ideas (Ninj and Terzieva, 2015). The IS literature has slowly begun applying complex adaptive systems lens to various contexts (Nan and Tanriverdi, 2017; Nan and Lu, 2014).

Both chaos theory and dissipative structure theory focus on the macro level emergence (Burnes, 2005). Chaos theory treats a system as deterministic and focuses on only a small set of non-linear interactions (Cilliers, 1998). In dissipative structure theory, emergence occurs as a result of spontaneous self-organized fluctuations and even with the knowledge of initial conditions, the final structure cannot be predicted (Jantsch, 1980). Dissipative structures have the ability to explain emergence and self-organization with the consideration of feedback loops (Chiles et al., 2004). Given its properties, studies in social sciences utilize dissipative structure theory to understand emergence during various change processes, including in small group interactions (Smith and Comer, 1994), organizational change (Gemmill and Smith, 1985; Jantsch, 1980; Leifer, 1989; MacIntosh and MacLean, 1999), and social systems (Smith, 1986; Smith and Gemmill, 1991). Therefore, in this paper, we will also use dissipative structure theory as our framework for the emergence of a new structure as a result of IT-enabled change process.

The roots of dissipative structure theory reach to the studies by Prigogine and his colleagues in chemistry. According to Nicolis and Prigogine (1977), systems show two different behaviors; coherent and disorder. More specifically, systems show coherent behavior at near-equilibrium state and experience disorder at far-from-equilibrium state (Jantsch, 1980). As a result, destruction of order occurs when systems are near their equilibrium and creation of order occurs when systems are far from their equilibrium (Liu, 1996). From this perspective, dissipative structures resemble going through cycles of gradual and episodic change periods (MacIntosh and MacLean, 1999). According to the dissipative approach, at the decision point, namely the bifurcation point, systems show non-linear characteristics. Therefore, a small change at the bifurcation point can lead to dramatic

changes since the effect of an action is not proportional to its cause as it is in linear relations. The ‘dissipative’ term refers to “absorbing useful energy and expelling the useless energy” (MacIntosh and MacLean, 1999, p. 303) and highlights the importance of continuous energy and matter transfer.

Compared to traditional views of IT-enabled change, dissipative structure theory is advantageous because it does not impose strong assumptions and it encapsulates all stages during an implementation cycle. Traditional approaches try to predict the implementation result using a deterministic view – given all possible contingencies, the implementation is bound to be successful. However, IT implementation processes may last for months or even years, during which organizations may encounter various challenges and uncertainties that are different from stage to stage. Rather than emphasizing those contingencies that determine the results, dissipative structure theory focuses on the factors that drive the implementation process to proceed. As indicated by Prigogine in his original work, the dynamism within the system is a source of energy that breaks the system’s equilibrium status so that the system can continuously improve itself (Jantsch, 1980). Contrary to the extant research on IT implementation, which is more interested in examining how the system can reach a stable status such as successful implementation, the dissipative structure framework adopts a different perspective and considers that the implementation results are “unplanned” and the organizational system is facilitated to progress, not to settle.

Moreover, the continuous energy transfer in dissipative structure theory provides a unique view of the IT implementation process in organizations. The decision to implement an IT innovation creates the necessary initial energy inflow and brings the organization to a bifurcation point. This inflow of energy is referred as a trigger effect (e.g., jolts) by the traditional episodic change view. Yet, traditional approaches neglect the need for continuous energy inflow and energy outflow to proceed towards a goal state. Groups and organizations can maintain their structural order only by dissipating large amounts of energy, information, and resources (Lichtenstein, 2000a). The outflow of energy is the process of discarding unnecessary, obsolete, or replaced parts of the organization during implementation. The dissipative structures approach, therefore, reminds organizations and managers that implementation of IT can be successful only through continuous guidance and proper removal of conflicting rules, regulation, incentives, and sometimes the legacy IT.

#### **CONDITIONING THE EMERGENCE PROCESS**

While randomness is an important part of the self-organization process, individual behavior and decisions in social systems are not truly random, but rather limited with a finite set of perceived choices shaped by past choices (Mitleton-Kelly, 2003). Organizations, for instance, start the self-organization process by redefining their existing mission (Lichtenstein, 2000c, p. 139). Unlike living organisms in nature, organizations have the ability to create favorable conditions for the success of the transformation (MacIntosh and MacLean, 1999, p. 306). Therefore, it is possible for an organization to “determine the characteristics of the archetype without necessarily prescribing its exact form” (MacIntosh and MacLean, 1999, p. 306). We argue that organizations can condition the emergence of the new structure during IT implementation through actively pursuing intentional unlearning and learning processes supported by an appropriate managerial rhetoric. These initiatives can provide the necessary continuous energy inflow to create the negative feedback to counter the positive feedback resulting from various sources of organizational inertia.

#### **Organizational Learning and Unlearning**

Organizations learn and unlearn through their members. Individual learning occurs at the cognitive level from day-to-day activities of individuals as they build their portfolio of responses to various stimuli. Organizational learning occurs as a result of capturing, sharing, and applying knowledge of individuals (Chiva, Grandio, Alegre, 2010). A majority of the literature defines organizational learning as the acquisition of new knowledge and routines (Tsang and Zahra, 2008). However, even though organizations learn through their members, organizational learning is not the sum of all individual learning (Hedberg, 1981). On the other hand, the individual unlearning process is considered more complex with varying views from different fields. It can be conceptualized as either the change or deletion of a response to a particular stimulus, or change of perception of the stimulus, which consequently leads to new responses while discarding the old responses. Similarly, organizational unlearning refers to discarding of old routines to make way for the new ones (Tsang and Zahra,

2008). It is important to note that, rather than completely discarding old routines, an extensive modification of these routines can also result in individual/organizational unlearning.

Both learning and unlearning have equally important roles in adding new knowledge and achieving successful change (Hedberg, 1981). Studies on routines and change in the organizational learning literature postulate that organizations need to unlearn the existing routines before learning new ones. For instance, in his highly cited three-stage model, Lewin (1952) suggests that change first involves unlearning through changing mental structures and cognitive restructuring, and this is followed by adoption of a new mental model. Unlearning is embedded in the organizational change process (Akgün, Byrne, Lynn, Keskin, 2007), and, to a degree, the success of the change process depends on how much the organization relieves itself from its existing routines and workflows. Therefore, only after forgetting and discarding the existing routines and structure (organizational unlearning), can we expect the emergence of new routines and structure (organizational learning). It is important to note that learning and unlearning are not discrete processes and both can take place simultaneously at the organizational and also at the individual level.

### **Rhetoric as Managerial Intervention**

When an IT innovation is introduced to an organization, individuals start the sensemaking process and their interpretation guides their action towards the new IT (Griffith, 1999; Orlikowski and Gash, 1994). Managers can give meaning to the innovation through framing and social construction (Dearing and Meyer, 2006), and they can also change individuals' interpretations in favor of the new IT (Azad and Faraj, 2011). In other words, managers can be the drivers of the necessary organizational climate for successful implementation and change (Klein et al., 2001; Klein and Sorra, 1996). An aspect of the attention-based view of organizations also posits the use of strategic vocabularies and rhetoric tactics to affect the patterns of organizational attention to generate strategic change (Ocasio et al., 2015).

Given the effectiveness of language and communication in constructing social and organizational reality (Heracleous and Barrett, 2001), scholars in management science utilized discursive and rhetorical approaches to study organizational change (Ford, Ford, D'Amelio, 2008; Hartelius and Browning, 2008; Heracleous and Barrett, 2001). Discourse is an overarching term for spoken and written communication and how language constitutes a human activity (Hartelius and Browning, 2008). Rhetoric, on the other hand, is the spoken dimension of discourse (Hartelius and Browning, 2008). Rhetoric is used to purposefully communicate values and persuade others to accept ideas and practices as well as enact reality (Cheney, Christensen, Conrad, Lair, 2004; Dearing and Meyer, 2006; Hartelius and Browning, 2008).

Recently, a number of studies used rhetoric in the IS literature to examine IT adoption in various contexts including a straight through processing system (Huang and Galliers, 2011), free and open software (Barrett et al., 2013), social media (Huang, Baptista, Galliers, 2013), back office messaging system (Hsu, Huang, Galliers, 2014), and cooperative work software (Hayes and Walsham, 2000). Huang, Hsu, and Galliers (2011) proposed rhetoric affordance as an overarching framework for adoption and diffusion of innovation. They described rhetoric affordance as "a discursive journey that is continuously shaped, enabled and influenced by the presence and understanding of, and changes in, rhetorics within a particular social context" (p.6). Given that technological change involves stakeholders with conflicting interests, various types of rhetoric can be used to outline the nature of the technology, necessity for the technology, importance of change, and competence of users (Symon, 2008). Thus, a fit between rhetoric and the IT implementation stage is necessary to achieve success.

Parallel to this contingency argument, Sillince (2005) proposed that a rhetorical congruence is necessary to achieve a successful fit between strategy/structure and environmental contingency. He suggests four rhetorical processes in this framework. *Emphasizing context* has the purposes of drawing attention to the context. *Switching perspective* combines several voices to point out the existence of different opinions and contradictions. *Creating consistency* has the purpose of unification. Lastly, *creating purpose* is useful to increase motivation as well as create momentum. Sillince (2005) grouped these four rhetorical processes into two. Emphasizing context and switching perspective are grouped under differentiation rhetoric, which facilitates exploration and flexibility.

Creating consistency and creating purpose are grouped under integration rhetoric, which is designed to create convergence to exploit the existing information.

**Conditioning through the Stages of Dissipative Structure Theory**

We postulate that the IT implementation process needs to start with an *unlearning* process followed by a *learning* process. The organizational learning theoretical framework is suitable given the role of old and new routines for the success of the IT implementation (Edmondson et al., 2001; Robey and Sahay, 1996). However, IT implementation has a better chance for success when this learning process is actively managed by organizational leaders compared to an adaptive learning process that occurs naturally (Edmondson et al., 2001). We believe managerial rhetoric can support the learning and unlearning processes since both of these processes heavily depend on changes in individual cognition.

We conceptualize the dissipative structure model in two main phases. In the first phase, the organization distances itself from the existing form. This part includes the *disequilibrium* and *symmetry breaking* stages, and the organization discards old routines and old mental models through the unlearning process. In the second phase, the emergence process begins and the organization starts to get closer to its new form. Through the *experimentation* and *reformulation* stages, individuals start learning and the organization starts to have new routines. This phase results in many inefficiencies in the form of unused mental models and structures, and these are continuously discarded as entropy.

Table 1 outlines the different stages of emergence in dissipative structure theory and corresponding feedback mechanisms and energy outflows during IT implementation. Types of inertia in Table 1 are the dominant type in that particular stage. It is likely that all sources of inertia play a role throughout implementation, yet we attempt to identify the dominant type of inertia based on the features of the stage. In the next section, we provide a detailed discussion of the interplay between positive feedback and negative feedback in each stage of the emergence process.

<b>Stages of Dissipative Structure</b>	Disequilibrium	Symmetry Breaking	Experimentation	Reformulation
<b>Relation to Complexity Theory</b>	Bifurcation point	Edge of chaos	Self-organization	Self-referencing
<b>Sources of Inertia as Positive Feedback</b>	Political inertia	Individual resistance	Discontinuance of use	Cultural conflict
<b>Learning practices as Negative Feedback</b>	Organizational unlearning	Individual unlearning	Individual learning	Organizational learning
<b>Managerial Rhetoric as Negative Feedback</b>	Emphasizing context	Switching perspective	Creating purpose	Creating consistency
<b>Discarded Entropy</b>	Old routines	Old mental models	New inefficiencies	Unused structures

**Table 1. IT implementation and the emergence process based on dissipative structure theory**

*Disequilibrium Stage*

In the first stage of dissipative structure theory, the system requires an external or internal force to move away from its near equilibrium state. This force takes the system to a bifurcation point. Bifurcation points represent points where a stable structure becomes unstable and alternative paths become available for self-organization and emergence of the new structure. This stage is similar to the revolutionary periods in the punctuated equilibrium model where organizations move away from their equilibrium (Gersick, 1991). The main difference is in the



traditional punctuated equilibrium view, assuming the change is successful, the system moves from an equilibrium to the next favorable and planned equilibrium, whereas in dissipative structure theory, paths that branch out at a bifurcation point cannot be predicted and the new structure emerges at a near equilibrium state.

Organizations can only reach the disequilibrium stage after they break their organizational inertia. Different kinds of events can break inertia and promote organizational change, including mergers, major lawsuits, changes in top management, and changes in regulations. The introduction of new technology, such as adoption of new software products, can also create the necessary internal force to move organizations from their equilibrium (Lassila and Brancheau, 1999). Nevertheless, it is necessary to identify and address the factors that hinder the change before IT is introduced to users since IT alone cannot accomplish the needed radical change (Markus, 1983). At this stage, one of the significant sources of inertia concerning IT implementation is political inertia. Power and politics have been an important factor in IT implementation since the early days of information systems (Markus and Pfeffer, 1983), and this notion continues to find support in more recent IS literature (Constantinides and Barrett, 2006; Grover, Sabherwal, Raman, Gokhale, 2014; Jaspersen, Carte, Saunders, Butler, Croes, Zheng, 2002). IT implementation faces political inertia because the implementation process is likely to shift the power distribution in the organization (Baskerville and Smithson, 1995; Jaspersen et al., 2002). Organizational members perceive data as a political resource rather than an intellectual commodity, and redistribution of data through new information systems can have a direct effect on particular individuals and groups (Keen, 1981). This alteration of power dynamics causes some members of the organization to gain and others to lose power. Inertia tends to be supported by the members who are more likely to lose their power (Markus, 1983).

Since the primary goal in the disequilibrium stage is to break this political inertia, a strategy for successful implementation of IT has to consider organizational politics (Keen, 1981; Markus and Pfeffer, 1983; Markus, 1983). At this initial stage, one of the effective negative feedback mechanisms is to initiate the organizational unlearning process since unlearning old routines is essential to changing those routines (Mezias et al., 2001). Organizational routines are repetitive, recognizable patterns of interdependent actions, carried out by multiple actors. An organizational routine consists of two parts; the abstract idea of the routine and the actual performance of the routine by specific people (Feldman and Pentland, 2003). Parallel to structure and agency in structuration theory (Giddens, 1984), the ostensive aspect of the routine relates to structure and the performative aspect of the routine relates to agency (Feldman and Pentland, 2003). The organizational unlearning process to discard the old routines starts with the ostensive aspect followed by the performative aspect (Tsang and Zahra, 2008). In other words, the unlearning process starts with *organizational* unlearning and continues with *individual* unlearning (Tsang and Zahra, 2008).

The unlearning process, however, can still be insufficient to overcome political inertia (Mezias et al., 2001), since a shift in collective cognitive may be necessary to overcome existing inertia (Mezias et al., 2001). Therefore, managerial interventions as supplemental negative feedback are likely to increase the success rate of IT implementation. As discussed earlier, the use of rhetorical processes is an effective way to achieve cognitive changes. Assuming that the IT implementation decision is rational for the organization, in this stage, the main purpose of the rhetoric would be to explain why “old ways” are not good for the organization anymore and how the implementation of the new IT would benefit the organization as a whole. While decision makers may already be aware of this rationale, they have to communicate it to the rest of the organization. Failed translation of intent can result in strategic blindness where even a successful IT implementation would not result in a change that achieves the strategic intent (Arvidsson, Holmstrom, Lyytinen, 2014). At this early stage, managers can use the *emphasizing context* rhetoric to overcome political inertia since contextualization helps to highlight certain relevant information within the message (Gumperz, 1992). Examples of such rhetoric include explicitly stating the reasons for implementing the new IT and how the new IT will benefit the organization. The perceived legitimacy of reasons behind the change increases the chance of success of the implementation process (Rousseau and Tijoriwala, 1999).

#### *Symmetry Breaking*

Symmetry breaking is one step beyond disequilibrium, where organizations free themselves from inappropriate arrangements (Smith, 1986). Gemmil and Smith (1985) define symmetry breaking as breaking the existing

functional relationships and patterns of interaction. While symmetry breaking brings the organization closer to chaos, it also enables more degrees of freedom for changes and experimentation (Gemmill and Smith, 1985; Smith, 1986). This far-from-equilibrium state gives individuals the opportunity to experiment and explore possible solutions to create new patterns (Mitleton-Kelly, 2003). One of the characteristics of this edge of chaos state is that behavior becomes unpredictable. However, in an organizational context, the unpredictability of behavior is limited due to organizational rules, processes, and common sense in general (Stacey, 1995).

This stage is a continuation of the previous stage where the dismantling of existing routines continues. The unlearning process that has started at the organizational level continues at the individual level. Individual unlearning involves discarding the performative aspects of routines, and it refers to cases where an organizational member realizes that the knowledge she possesses is no longer valid and stops enacting certain routines (Tsang and Zahra, 2008). Individual unlearning creates opportunities for new responses and mental maps (Hedberg, 1981) and hence opens the way for new learning to occur (Huber, 1991).

The most significant positive feedback at this stage would be resistance to use the new IT. We consider resistance as passive rejection – deliberately not using the technology. Examples of resistance can range from apathy to complaining and sabotage (Lapointe and Rivard, 2005). However, despite the generally negative connotation associated with change, it is likely that organizational members initially welcome a new IT rather than immediately resisting it. For instance, instead of using a spreadsheet program for customer service, using an enterprise system that integrates the marketing department and promises many new efficiencies and features sounds optimistic at the beginning. Users can continue to have a positive outlook even after the start of the implementation process since the new IT is still more of an abstract idea, which does not necessarily indicate how it will create the change or affect the users. That is, even discarding the ostensive aspects of routines in the previous stage does not necessarily create resistance from the users because, in their everyday tasks, users interact with the performative aspects of the routines. Lapointe and Rivard (2005) argue that resistance starts at the interaction of the object of resistance (e.g., the new IT) and initial conditions (e.g., existing routines). Most prominent studies of resistance to IT argue that resistance results from the evaluation of contextual factors such as perceived fear rather than the evaluation of the system itself (Joshi, 1991; Lapointe and Rivard, 2005; Markus, 1983). Therefore, as the individual unlearning process progresses, users will start experiencing its effect through changing workflows and routines, and this realization of unanticipated consequences would lead to potential resistance (Markus, 1983).

An essential goal of the managerial rhetoric at this stage is to prevent individual level resistance escalating to group level resistance, since resistance is likely to inhibit implementation only when a significant number of users resist (Lapointe and Rivard, 2005, 2007). Managers should attempt to change the perceptions of users to prevent or minimize resistance (Joshi, 1991; Judson, 1991). Using the *switching perspective* to consider different point of views and contradictions as a continuation of differentiation rhetoric can reduce resistance and increase the likelihood of replacing old mental models with new ones. Examples of this rhetoric include role taking, speaking in someone else's voice, and distantiating to alter agency and subjectivity to reduce bias and provide alternative opinions (Sillince, 2005).

#### *Experimentation*

Self-organization is a decentralized process in which activities at the micro level lead to the spontaneous emergence of a new structure at the macro level. In the experimentation stage, the system creates a variety of new forms through a self-organization process. These new forms require more than merely building on the old structure. Therefore, it is vital for organizations to discard their old routines and mental models and complete or be in advance stages of the unlearning process. Having a variety of forms through experimentation increases the probability the dissipative structure will reach a single effective system (Smith, 1986), since some of these forms, which may seem as inappropriate at a certain point in time, are likely to be a part of the new configuration of the system (Gemmill and Smith, 1985).

From the IT implementation perspective, the experimentation stage starts when users start interacting with the new IT. Innovation literature scholars have argued the importance of such an experimentation period since a fast

implementation process may lead to unexpected and counterproductive results whereas a period of trial and error increases the success chance (Hughes, 1971; Rogers, 1995). The experimentation period can be envisioned as a period where users start reframing the new technology and attempt to do their workflows using the new IT. In other words, users start creating the performative aspect of the routines through individual learning. Experimentation creates an opportunity for individuals to have experiences, and this subconscious intuiting process leads to a conscious interpreting process where individuals create their cognitive maps (Crossan, Lane, White, 1999).

Intentions to use and actual use of the new IT are essential activities during the experimentation stage. Factors affecting users' intentions and behavior have been investigated thoroughly in the IS literature. These studies reported several antecedents including attitudes (Davis, 1989), perceptions (Davis, 1989), self-efficacy (Compeau and Higgins, 1995), innovativeness (Leonard-Barton and Deschamps, 1988), and prior experience (Taylor and Todd, 1995). Given that adoption is closely related to individuals' characteristics and perceptions, each user is likely to have a different experience during experimentation.

Experimentation also creates an opportunity to reduce the discrepancy between the expectations of the users from the new IT and its actual capabilities and default state. The amount of discrepancy at the beginning of the experimentation stage defines how each organization experiences this stage. During experimentation, organizations create variety and increase the possibility of an emerging structure that minimizes this discrepancy (Smith, 1986). However, experimentation can take place only if the users start interacting and continue to interact with the system.

The major positive feedback in this stage is twofold; non-use and discontinuance. Most studies in the IS literature consider resistance to use a technology as the opposite of using that technology. While resistance and non-use may have the same consequence (i.e., new IT not being used), the assumptions and drivers of each behavior are different (Cenfetelli, 2004; van Offenbeek, Boonstra, Seo, 2013; Wolverton and Centefelli, 2019). Resistance behavior is based on inhibitors and acceptance behavior is based on enablers, and, therefore, these are not opposite factors but rather independent constructs having distinct effects (Cenfetelli, 2004). Non-use occurs when users do not try the new IT. These users are symbolic rejectors and are disinterested toward the new IT (Wolverton and Centefelli, 2019). This behavior may reveal itself due to inertia caused by the attachment to and persistence of the existing IT as users continue to use the existing system subconsciously as part of their habit or consciously due to perceived switching costs to the new IT (Polites and Karahanna, 2012). Discontinuance, on the other hand, occurs when users stop using the new IT before it is routinized and habitualized. These users are trial rejectors and tend to be loyal to the current technology (Wolverton and Centefelli, 2019). However, discontinuance is not necessarily related to the incumbent system but can also be as a result of low perceived usefulness and ease of use of the new system, or users' general dissatisfaction with the new system (Bhattacharjee, 2001; Limayem, Hirt, Cheung, 2007; Polites and Karahanna, 2012).

Adaptation to uncertainty is likely to be unsuccessful if rhetoric that focuses on differentiation (i.e., emphasizing context, switching perspective) is not followed by rhetoric that focuses on integration (i.e., creating consistency, creating purpose) (Sillince, 2005). Therefore, after a period of high uncertainty during unlearning and discarding of old routines, managers should start focusing on rhetoric that provides stability to support the learning process. This stage is a transition stage, where two technologies can co-exist in the organization. A paradox management may be necessary to foster learning and address decision indeterminacy (Lauritzen, 2017). Given the nature of the positive feedback, managerial rhetoric should focus on motivating the users by creating a purpose for interacting and experimenting with the new IT. A rhetoric that *creates purpose* can increase commitment and motivation, trigger sensemaking, and promote the organization's interest and directions (Sillince, 2005). Users need support for experimentation, and the amount of experimentation is moderated by leadership (Smith and Gemmill, 1991). Managers can create purpose by using rhetoric that focuses on hortative sentences and action words linked to the mission, vision, or scenario in hand to motivate and direct the users during the experimentation stage (Sillince, 2005).

*Reformulation*

In the last stage of dissipative structure theory, the system selects a new configuration from a repertoire of configurations experimented in the previous stage. These new configurations can be considered as attractors. An attractor is an end state where the change process finishes and the system settles down around its deep structure at near equilibrium state. Attractors are a feasible set of alternatives at the macro level, and the randomness at the micro level is limited to the boundaries of these attractors. The final new configuration is the one that optimizes the energy throughput and openness to other systems in the environment (Gemmill and Smith, 1985).

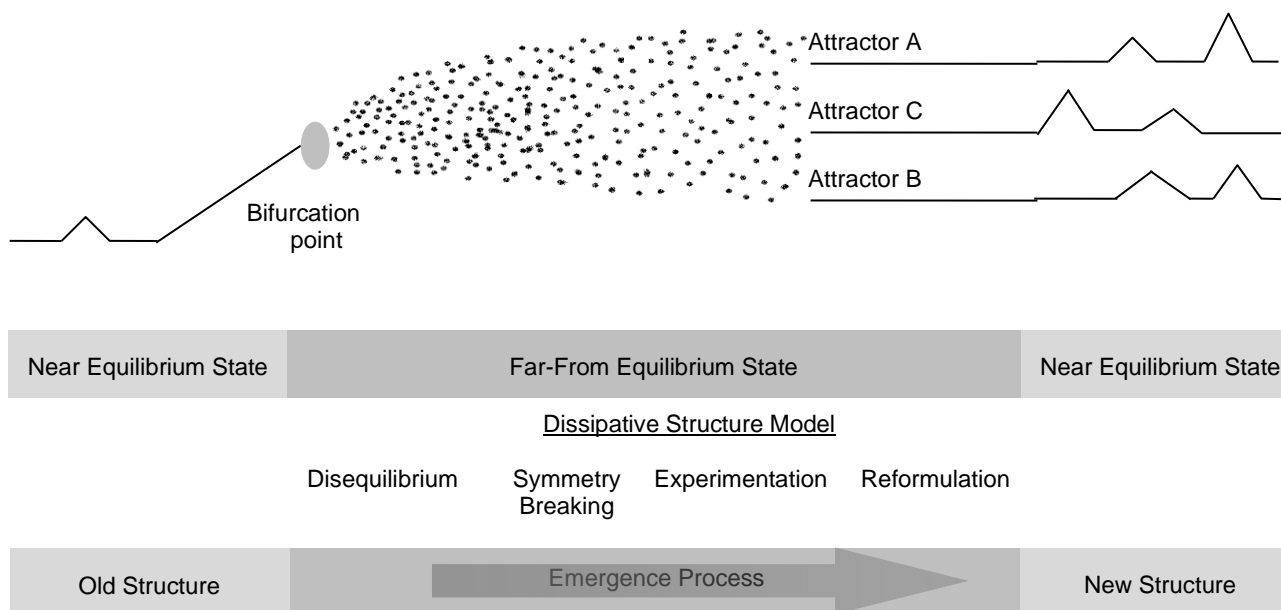
The final configuration, however, should be consistent with the history and the present state of the system to prevent a completely random reconfiguration. Therefore, organizations going through a change process need to be self-referencing similar to an autopoietic system. An autopoietic system exchanges energy with the environment yet its pattern is determined by the system itself rather than the environment (Burke, 2013; Jantsch, 1980). To achieve autopoiesis, organizations should look to their own deep structures (i.e., the core of the organization) rather than outside for reference, information, identity, and ability to assess experimentation (Smith and Gemmill, 1991). The rationale for this is simple: every organization is different, and therefore, it cannot look at a competitor and copy how it created its structure. Moreover, autopoiesis ensures that the identity of the organization stays the same after the change process (Burke, 2013).

From the IT implementation perspective, three main attractors can be identified for organizations. Attractor A is the complete success of the implementation of the new IT. This is the most desirable attractor, at least from the decision maker's perspective. Attractor B is the failure of the implementation and returning to the previous workflow and structure. This is the least desirable outcome for the decision maker since the process will be a complete failure after exhausting resources of the organization during the implementation process. Attractor C falls between the previous two attractors. More specifically, users utilize the new IT yet try to circumvent some of its features in order to follow their previous routines, which is a natural consequence of not being able to separate individual unlearning and learning processes. This outcome is less desirable than the successful implementation, yet it may still be desirable since, in the long run, when organizational learning initiates and users reach the top of the learning curve, there is a possibility of leaving the circumventing behavior and fully adopting the new IT.

However, changes in power and work habits as a result of the implementation of new IT can conflict with the existing shared norms, values, and meanings, resulting in a culture-based inertia (Cooper, 1994). Therefore, in the reformulation stage, the main positive feedback arises as a result of conflict between existing organizational culture and the culture imposed by the new emerging structure. It is important to note that organizational culture may start creating positive feedback before the implementation stage, such as during the elaboration of the adoption idea (Van de Ven, Polley, Garud, Venkataraman, 2008). The cultural conflict may also be present in the stages before the reformulation stage, however, in the earlier stages, though being slowly dismantled, the old structure still exists in the organization, thus, the change exerts a minimal effect on the organizational culture and norms. Organizational members are likely to begin experiencing the effect of the new IT on culture towards the end of the change process as experimentation advances, new routines develop, and the new structure slowly emerges. Moreover, roles and role relationships would change only after the formation of the new routines (Leonardi and Barley, 2010). When IT conflicts with the existing culture, the likelihood of IT implementation failure increases (Romm, Pliskin, Weber, Lee, 1991). Due to existing culture and norms, it is possible that organizational members will favor a structure that is similar to the former one and attempt using the new IT with the old structure. This attempt will likely pull the organization towards an attractor that has a similar or same structure as the former structure. In this situation, despite the success of the implementation, the strategic intent of the new IT would not be achieved.

In practice, as a result of the non-linearity of the emergence process (shown as dots in Figure 2), it is not possible to predict which attractor the organization will finally reach. It is not clear whether attractor C will be closer to success or failure. This final stage is where the ostensive aspect of routines is built. Individuals with new cognitive maps will start creating shared understanding as part of organizational learning, consequently leading to the institutionalization of new rules, procedures, and routines in the organization (Crossan et al., 1999). After a period of inefficiencies and trial-and-error during the experimentation stage, in the reformulation stage,

managerial rhetoric should focus on *creating consistency* across the organization to finalize the implementation process. This rhetoric on consistency achieves unification and enables sensemaking through shared experience (Sillince, 2005). Managers can create shared meaning and build organizational identity around the new technology. Examples of rhetoric that focus on creating consistency are inclusiveness, such as “we,” highlighting organizational identity and “official” view, and creating dissonance reduction to bring together opposing views into unification (Sillince, 2005).



**Figure 2. Dissipative structures approach to organizational change as a result of IT implementation**

### AN APPLICATION OF DISSIPATIVE STRUCTURES THEORY

In this section, we apply dissipative structures theory to a secondary case study – Orlikowski’s (1996) seminal work on practice-based model of organizational transformation. Our goal is to illustrate how the findings of this case study co-align with the emergence process discussed above. This case study focuses on the implementation of an incident tracking support systems for the customer support department of a software company. With this study, Orlikowski revealed that IT-enabled change rarely unfolds as planned, but rather, the entire process carries characteristics of randomness and emergence.

The case study captured five metamorphosis stages the organization went through as part of its change process. Each stage revealed deliberate and emergent changes in practices as well as unanticipated outcomes of the implementation. In the early-stage metamorphoses, the main challenge was user resistance. For example, after the implementation of the new system, employees were required to enter calls to the system but they found workarounds and continued to do their old routines. As a response, managers redistributed work and responsibilities with new positions, roles, and hierarchical levels. This is a good example of the organizational unlearning process we have discussed in our emergence process, where the main goal is to discard ostensive routines. However, even after the creation of these roles, initially, the employees restrained themselves from using the new levels and roles. Eventually, managers made more structural changes, such as adjustments of employee evaluation criteria, to reinforce the unlearning process.

In the later-stage metamorphoses, Orlikowski identified the change in norms and procedures. For instance, the specialists started providing more proactive help in solving customer issues, which led to collaboration and eventually increased effectiveness. At the same time, more courteous and diplomatic interactions were formed

among the employees. However, the employees continued to experience difficulties while using certain features of the ticketing systems. The challenges of this experimentation stage were overcome with a new guideline for procedures and new norms regarding the use of the system.

The comparison of Orlikowski's case study to the stages of emergence process in this paper shows similarities. First, in the initial stages, there was user resistance at the individual level, and this was addressed by discarding old routines, where the organization redistributed work and responsibilities and changed the criteria for employee evaluation. Second, in the later stages, while employees were experimenting with the ticketing system, their frustration and challenges were addressed by new norms and procedures at the organizational level. This analysis reveals that while unlearning and learning are relatively distinct and sequential, the organizational and individual levels of learning/unlearning are more synchronous, where organizational learning (unlearning) reinforces individual learning (unlearning) and both levels affect each other during the process.

A third similarity arising from this comparison is the important role of managers during the change process. In Orlikowski's case study, managers had constantly adjusted structural factors. These findings support our arguments regarding the critical role of managerial interventions. Without such intervention and support, the implementation process is prone to failure. Orlikowski's findings also revealed that managerial interventions showed emergent characteristics as well, leading to unplanned managerial behaviors and action. This interaction between organizational level and individual level emergence highlights the importance of initial conditions at organizations, and how small changes in the process can lead to different outcomes, thus partially providing an explanation of varying effects of the same technology across organizations.

## DISCUSSION

Given the ever-changing nature of business and technology environments, organizations are never at an equilibrium, but constantly changing. At times of a radical change, organizations move from their near-equilibrium state to a far-from-equilibrium state, where their new structure emerges. These periods of transition are generally unstable, and change does not necessarily lead to a favorable state (Lassila and Brancheau, 1999). Randomness, chance, and self-interest can drive the emergence process to a different final state. However, we postulate that in social systems like organizations, the emergence process can be influenced to create the best possible chance to reach the goal state after the change. Managerial interventions can be effective in controlling the randomness created by self-interest driven organizational members by limiting their perceived choice. That is, during transition periods, managers and their guidance can increase the success rate of the implementation (Lassila and Brancheau, 1999) since managerial interventions can minimize the unpredictability during these periods (MacIntosh and MacLean, 1999). However, managers need to have a good understanding of the implementation process to be able to intervene and condition the emergence as much as possible (Brancheau and Wetherbe, 1990).

In this paper, we present a framework based on dissipative structure theory under the umbrella of complexity theory to provide a more granular understanding of organizational change as a result of new IT implementation. We build on the *emergence* view and postulate that an organization-wide implementation of IT leads to the emergence of a new organizational structure. Moreover, we illustrate how unlearning and learning processes supplemented with proper managerial rhetoric can be used to condition this emergent process. Traditionally, studies that examine the effect of IT on organizational structure assume that the emergence of a new structure is a linear process and the final structure is intended. The growing body of literature, on the other hand, posits that the characteristics of organizations become non-linear, almost chaotic, during the implementation process. Given that non-linearity is an essential part of the emergence process in complexity theory (Goldstein, 1999), we argue that approaching IT implementation from a complexity theory perspective offers a more accurate understanding of the emergence process.

Utilizing the theoretical lens of dissipative structures has several benefits over traditional linear views, especially in terms of highlighting the effects of non-linearity and unpredictability during self-organization at far-from-equilibrium state and the emergence of a new structure at an attractor. First, the implementation stage takes the organizations through different states. Each state has its own positive feedback to bring the organization back to

the old structure and requires an apposite negative feedback to move the organization towards the new structure. Second, dissipative structure theory considers both micro and macro levels and examines how changes in the micro level affect the macro level. From the IT implementation perspective, this characteristic highlights processes necessary both at the structure level and agency level. Third, dissipative structure theory encompasses both inflow and outflow of energy to the systems. This energy transfer, especially the outflow of energy, draws attention to the importance of the unlearning process, which is essential for the successful creation of routines based on the new IT innovation. Overall, we believe that framing IT implementation using dissipative structure theory provides a more granular view necessary for a better understanding of the emergence process, which in turn, creates opportunities for organizations to influence the process to increase the success rate of the implementation.

In addition to framing IT-enabled organization change using dissipative structure theory, we further contribute to the existing literature by outlining how managers can use rhetorics to condition the emergence process. In such complex environments, the manager's role changes from top-down and full control to managing order and disorder at the same time while encouraging experimentation and divergent views (Burnes, 2005). Rhetorical view highlights managers' active role during the implementation process beyond their commitment. Based on Sillince's (2005) theory of rhetorical congruence, we postulate that managers need to use different types of rhetoric that corresponds to the implementation stage. In the early stages, the rhetoric should focus on creating *differentiation* to facilitate the unlearning process by giving context and corroborating multiple perspectives. As the implementation progresses, the rhetoric should move towards *integration* to facilitate the learning process by giving purpose and creating unification. Successful IT implementation requires a shift in the collective cognition, and using managerial rhetorics is an effective method to achieve this. Moreover, the rhetorical approach gives a nuanced view of agency in IT innovation adoption phenomena (Barrett et al., 2013), especially at the interconnection of agency and structure (Green, 2004). This multi-level approach provides a better understanding of the implementation process (Aubert, Barki, Patry, Roy, 2008), yet it is mostly ignored in the literature (Nan, Zmud, Yetgin, 2014).

Our framework is not without limitations. One limitation is the assumption that the implementation decision gets the full support of the management team. However, in practice, this may not be the case, and implementation can start with partial approval of managers. Moreover, our framework does not consider situations where the implementation of an IT innovation eliminates the human agency. For instance, if organizations completely remove the incumbent IT after implementing the new IT, there is almost no room for agency. Furthermore, following the literature (Rogers, 1995), we assume that organizations begin experiencing the change in the implementation stage. However, it is likely that during the decision-making stage, organizations may take anticipatory actions to the upcoming IT implementation, thus the change process may start before the implementation stage. Future research can further investigate the dissipative structure model using case studies to provide richer details of each stage. Qualitative studies can also reveal the effect of anticipatory actions during the decision-making process, providing a better understanding of the change process. Another important contribution of future research would be the effectiveness of various unlearning and learning practices during the implementation process. Lastly, researchers can combine the decision-making, implementation and post-adoption stages to arrive to a more complete understanding of the adoption process.

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