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Technology Change or Resistance to Changing Institutional Logics: The Rise and Fall of Digital Equipment Corporation

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Abstract

This article uses an institutional lens to analyze organizational failure. It does this through a historical case study of Digital Equipment Corporation, an innovator and market leader of minicomputers who faltered and eventually failed during the period of technological change brought on by the emergence of the personal computer. The failure of Digital Equipment Corporation is interesting because it occurred despite its ability to adapt to changing technological forces. An institutional analysis shows that while Digital Equipment Corporation was able to develop personal computers widely considered technologically superior to its competitors, it resisted broader changes occurring in its institutional context. This study suggests that responding to external forces of change, such as technology, may not be enough. An organization must determine if and how such change might lead to a shift in its institutional context and then develop strategies to address such change.

Organizational failure has received considerable attention over the decades (McKinley, 1993; Munir, 2005; Kam, 2005; McGovern, 2007; Mackie, 2012; Oertel, Thommes, & Walgenbach, 2016). What organizational failure is and how it occurs is complex, although an ability to anticipate and adapt to environmental changes has become a central focus in the literature (Weitzel and Jonsson, 1989). Technology change as an external force has received particular attention. It has been theorized as disruptive (Christensen, 1997), competence-destroying (Tushman & Anderson, 1986), impacting processes (Abernathy and Utterback, 1978), and obsoleting business models (Teece, 2010). In many of these models, technology change is seen as a threat to those organizations who are unable to adapt, leading them to irrelevancy or even failure. The message is clear—adapt to technological change or risk failure.

But how does one explain failure when an organization is able to adapt to technological change. This article explores such a case and proposes that organizational failure may be better understood through institutional analysis. It does this through a historical case study of the rise and fall of Digital Equipment Corporation, the inventor and market leader of the minicomputer that later faltered and eventually failed during a period of technological change brought on by the personal computer. By all accounts, Digital Equipment Corporation quickly adapted to this technology change and developed a line of personal computers that was widely considered to be technologically superior to other personal computers in the market. Yet, Digital Equipment Corporation still failed. The answer to this puzzle and contribution of this article is in the changing institutional context that occurred during the emergence of the personal computer.

In perhaps the only other academic study of Digital Equipment Corporation, Edgar Schein and colleagues pointed to its culture as being primarily responsible for its rise and fall (Schein, DeLisi, Kampas, & Sonduck, 2003). As an organization evolves, it needs to be able to

adjust and shift its culture to fit the predominant issues and challenges of that particular period in its life cycle. Digital Equipment Corporation, according to Schein et al., was unable to make this shift. While an important contribution toward understanding change, this perspective largely focuses on the organization and misses the key changes occurring in the environment and broader institutional context. This article seeks to add this perspective. It argues that culture and particularly technology change per se are not the primary cause for Digital Equipment Corporation's failure. Rather, it is a shift in the dominant institutional logics brought on by technology change, and Digital Equipment Corporation's resistance of this shift that led to the organization's demise.

Following a brief review of the literature on technology change, organizational capability, and institutional logics. Research methods of this study are then is presented followed by a historical account of the rise and fall of Digital Equipment Corporation, done through the lens of institutional change. An analysis of Digital Equipment Corporation's failure is then presented followed by implications for practice. This article concludes with suggestions for future research.

Technology Change

Technology change is an external force that can jolt an institutionalized field into a state of flux or destabilization (Hinings, Greenwood, Reay, & Suddaby, 2004). These jolts are difficult to anticipate and can threaten an organization's viability (Meyer, 1982). This is particularly challenging for an incumbent because technology change goes beyond the technology itself and impacts products, processes, markets, value propositions and business models (Tripsas, 2009). The literature of technology change is consistent with the broader change literature, categorizing modes of change as either incremental or discontinuous or radical. Incremental is first-order

change that supports and strengthen an organization's existing structures and competencies, while discontinuous is second-order change that poses a threat to those structures and capabilities (Tushman and Anderson, 1986; Bartunek & Moch, 1987; Meyer Brooks & Goes, 1990). The punctuated equilibrium literature was introduced as an integration of the two depicting change as long periods of incremental improvements that are punctuated by discontinuous breakthroughs (Tushman & Anderson, 1986; Gersick, 1991). This model has also been depicted as an S-curve, where existing technology incrementally grows until it reaches its natural limit, which is then overtaken by new technology causing discontinuous change (Foster 1988). In these conceptualizations, incumbents are theorized as having advantages during periods of incremental change but are at risk during periods of discontinuous change. During these periods of discontinuous change, an organization's product lifecycle could end quite suddenly (Utterback, 1994), find its existing capabilities irrelevant (Tushman and Anderson, 1986), and its business model obsolete (Teece, 2010).

Creating new product classes using new technologies can be risky for incumbents as it is a fundamentally different activity than incrementally improving and supporting what already exists. It requires different skills, processes, and activities (March, 1991; Boumgarden, Nickerson, and Zenger, 2012) and the tension between exploring new products and exploiting existing ones becomes a major organizational challenge (Andriopoulos and Lewis, 2009). This may explain why incumbents tend to use exploitation as a way to protect itself from new entrants but then become threatened when exploration creates discontinuous technological change.

Technology Change and Organizational Capabilities

Technology change can significantly impact an organization's capabilities. This can have strategic consequences in terms of an organization's ability to adapt to change. An organization's

core capabilities is what strategically differentiates itself from competition (Leonard-Barton, 1992). It is considered a set of differentiated skills, asset, and routines that become a basis for a firm's competitive advantage (Teece, Pisano, & Shuen, 1990). When technology changes, these advantages may no longer be sustainable. Core capabilities are developed to exploit the status quo (Christensen and Overdorf, 2000) through consolidation and higher barriers of entry (Tushman & Anderson, 1986). Exploiting industry-specific capabilities also increases the likelihood that incumbents are able to exploit technology within that industry (Mitchell, 1989).

But core capabilities become institutionalized, which leads to inertia, which leads to a paradox of core capabilities simultaneously enhancing and inhibiting an organization's development (Leonard-Barton, 1992). In other words, change can enhance an organization's competitive advantage through its core capabilities or destroy it (Tushman & Anderson, 1986).

Digital Equipment Corporation demonstrated it had the capabilities and ability to adapt to the technology change created by the emergence of the personal computer. It quickly developed a line of personal computers that were considered technologically superior to other personal computers on the market. Yet, Digital Equipment Corporation still failed. This suggests that the relationship between technological change, organizational capabilities, and organizational failure may provide an incomplete picture. To better understand this, a broader analysis of the changing institutional context and logics may be required.

Institutional Change and Institutional Logics

Institutional logics is embedded in the institutional theory literature, which argued that the dominant neoclassical economics literature provided an incomplete explanation of individual and organizational behavior (Friedland & Alford, 1991). While seen as a rational resource allocation system by neoclassical economics, organizations are also institutions influenced not

only be technical pressures but by social or institutional pressures (Meyer & Rowan, 1977; DiMaggio & Powell, 1983). Framed early on as rational myths (Meyer & Rowan, 1977) and rule like social facts (Zucker, 1977), Scott (2008) formalized institutions as being "comprised as regulative, normative and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life" (p. 48). Institutions provide context and meaning, which is then manifested into an archetype for organizing (Greenwood & Hinings, 1996). This includes cultural rules, cognitive structures, and material practices that form into institutional logics (Friedland & Alford, 1991; Thornton & Ocasio, 2008).

Thornton & Ocasio (2008) define institutional logics as socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality. It embodies both the symbolic (culture and cognitive structure) and the material (practices and processes) that form into taken-for-granted rules (Thornton & Ocasio, 1983) and organizing principles (Reay & Hinings, 2009). Institutional logics bring structure and order to organizations and organizational life. It can be viewed as a multi-level concept, focused on the societal level (Friedland & Alford, 1991), organizational field level (DiMaggio & Powell, 1983), industry level (Thornton and Ocasio, 1999), and organizational level (Prahalad & Bettis, 1986; Bettis & Prahalad, 1995).

These various levels form a relational effect. For example, organizations are embedded in organizational fields and industries. While market forces within fields and industries move organizations into particular structures so to gain technical efficiencies, social forces move organizations to adapt their organizational logics in order to gain or maintain legitimacy and power (DiMaggio & Powell, 1983). At the organizational level, Prahalad and Bettis (1986) and

Bettis and Prahalad (1995) describe how the collective mental model of the organization's top management team form into organizational logics that influence how it conceptualizes its business and filters information from broader environmental forces. Schein (1983) specifically points to an organization's founder's ability to influence its culture and logics. The founder brings to the organization his or her particular interests, beliefs, and ideas on how to better serve the existing market or create a new market, which in many ways drive its culture and material structure and practices.

While the literature on organizational institutionalism has focused on how downward pressure through isomorphism leads to convergent change that promotes stability and order through institutional logics, more recent literature has explored divergent change of the institutional context itself. Hinings, et al. (2004) describe a process where external forces such as social, regulatory, and technology can destabilize an existing institutional order and open it up to new possibilities. When this occurs organizations must make sense of such change and respond with their own innovations. In essence, these organizations, with their innovations, compete for the attention of the broader industry or field. As particular innovations diffuse across a field or industry, it becomes institutionalized into the "new normal." Organizations will converge to this new order, while those that resist risks irrelevancy or event failure.

This suggests that dominant institutional logics are not solidified and can shift towards new dominant institutional logics (Reay & Hinings, 2009). How an organization interprets and responds to such shifts becomes critical to its survival. This paper explores this through Digital Equipment Corporation's reaction to the shift in dominant institutional logics during the emergence of the personal computer.

Research Design and Methods

When beginning this research, several books were reviewed (see Rifkin & Harrar, 1988; Schein et al., 2003; Earls, 2004 for examples) in order to gain a broad sense of computer industry's history and the history of Digital Equipment Corporation. It is important to note that the computer industry, in this study, is defined as manufacturers of the mainframe, minicomputer, and personal computers. While each of these computer types represents a distinct era of computing, manufacturers often competed in all of these product markets. Digital Equipment Corporation was primarily a minicomputer manufacturer but moved into the personal computer market and even the mainframe market.

Data were collected primarily through secondary sources that included articles from trade publications and newspaper accounts between 1970 and 1998. This was done as a way to capture the voices of industry analysts, major customers, and managers and leaders at Digital Equipment Corporation as technological change occurred. A total of 219 articles were used, primarily from *The New York Times*, a daily newspaper covering all news including business and technology and *Computer World*, a trade publication devoted to computer and information technologies. Selecting particular articles began by simply using the company's name as a search criterion. Articles were quickly reviewed and those that were personal in nature, such as announcements of promotions, or product and technology reviews were dismissed. Articles that indirectly referenced Digital Equipment Corporation were also dismissed unless it related to a broader topic of the industry and Digital Equipment Corporation's history. In addition, eight in-depth interviews were conducted as a way to validate and supplement data collected from secondary sources.

The analysis was broken into two major phases. The first phase involved constructing a history of Digital Equipment Corporation that identified, organized, and recorded significant

points of time in its history. The intent of this history was to identify and explain periods of

change happening at Digital Equipment Corporation as well as the broader computer industry.

The second part of the analysis organized data into themes. This was done following Gioia's

method of first-order and second-order analysis (Gioia, Corley, & Hamilton, 2013). During first-

order analysis, themes and categories were identified, adhering faithfully to the voice of

secondary data as well as the interviewees. A repetition technique (Ryan and Bernard, 2003) was

used, looking at sentences and segments of sentences that seem to point to topics that occurred

and reoccurred. Second-order analysis was then used to identify patterns from themes and

categories. These patterns served as the basis to go back into the literature in order to analyze

why Digital Equipment Corporation failed. Before providing an analysis of its failure, a history

of the rise and fall of Digital Equipment Corporation is presented, starting with a brief

introduction of the company.

Logics at the Organizational Level: Introducing Digital Equipment Corporation

Digital Equipment Corporation was founded in 1957 by Ken Olsen and Harlan Anderson.

Inspired by their work as engineers at the Massachusetts Institute of Technology (MIT) Lincoln

Laboratory, they created Digital Equipment Corporation as a way to commercialize the

technologies being created at the Lincoln Laboratory and in particular their vision for a general

computer that was smaller, more interactive, and less expensive than existing mainframe

computers (Hughes, 1998). Harlan Anderson was the company's chief accounting and financial

officer, while Ken Olsen was president and chief executive officer (Rifkin, 1986).

Schein (1983) describes the importance of the founder in an organization's culture. Ken

Olsen would become a larger-than-life presence throughout Digital Equipment Corporation. Not

only did he have a significant stature within Digital Equipment Corporation but also throughout

the industry. In October 1986, Olsen appeared on the cover of Fortune magazine titled, "America's most successful entrepreneur" (Petre, 1986). The values, beliefs, and philosophies, and ultimately the organizational logics, of Digital Equipment Corporation were, in many significant ways, those of Ken Olsen. In Schein's inside story of the rise and fall of Digital (Schein et al. 2003), three chapters are devoted exclusively to Ken Olsen. Schein described Olsen as someone who believed in building an organization as a family where everyone was accepted, and debate and conflict resolution were the primary mechanisms for deciding what to do (Schein, 1998).

Ken Olsen was an engineer first and a business person second. While at MIT Lincoln Laboratories, Olsen enjoyed its entrepreneurial, yet collegial, environment where engineers were free to pursue their ideas and often collaborated together on various projects. Decisions on projects were made through open dialogue and many times through honest argument and political support. Through conflict, Olsen believed, the best answer would emerge. Ken Olsen would take this experience and build a company where engineers, not administrators, would lead.

This experience would influence the organizational logics of Digital Equipment Corporation. With its roots in the scientific and engineering research world, Digital Equipment Corporation became known as an engineer's paradise and as a result attracted the industry's best engineers. It resembled, in many ways, Olsen's life at MIT Lincoln Laboratory. Given its engineering-centric nature, Digital Equipment Corporation was committed to building, the highest quality and most technologically superior computers. Ken Olsen strongly believed that the organization with the highest quality and technologically superior computers will dominate the market. Digital Equipment Corporation's engineering design was seen as its competitive advantage. Because of this, proprietary technology became a cornerstone to its strategy.

Developing computers as a proprietary closed system was a way to protect one's technology and competitive advantage. Marketing become almost nonexistent. Ken Olsen believed that customers would seek out the highest quality and highest performing technology, and when they did, they would find Digital Equipment Corporation.

These beliefs manifested into organizational logics. Similar to Thornton & Ocasio (2008), Friedland & Alford (1991) defines institutional logics as a set of material practices and symbolic constructions that become organizing principles. By integrating these definitions with Prahalad and Bettis (1986) conceptual representation of organizational logics as the collective mental model of an organization's leaders, Table 1 presents Digital Equipment Corporation's dominant organizational logics.

-------------------TABLE 1 ABOUT HERE---------------------

The evolution of the computer industry

Digital Equipment Corporation's minicomputer represented discontinuous technology change. It created new applications, new accessibility, and a new market. With this change, Digital Equipment Corporation became a market leader and was considered a technological innovator and pioneer. This success reinforced Digital Equipment Corporation's dominant organizational logics. As a way to understand this within the broader institutional context, a short history of the evolution of the computer industry will be provided.

The early computer industry: The mainframe

Digital Equipment Corporation entered the computer industry in 1960 when the central product at that time was the large mainframe computer. These computers were designed to process large amounts of data and transactions through batched jobs typically run overnight.

These jobs were processed through centralized applications such as payroll, inventory, accounting and financial reporting, and customer data. Little interaction, if any, were required by computer users. Computer operators and specialists were hired to run these batched jobs as well as manage the maintenance of the mainframe computer and its associated computing environment. The size of the mainframe was such that it required its own temperature-controlled room typically far away from users. The computer architecture and design of mainframes was proprietary, not accessible to other companies or customers. What this meant was that consumers had to commit to a manufacturer's entire computing environment, both hardware and software. This required a large commitment, both financially and technologically and once a decision was made, the consumer was "locked in" to the manufacturer. This typically led to lucrative service contracts for manufacturers.

Given its cost and proprietary nature, mainframe computers were sold and serviced directly by the manufacturer. Their target market was large organizations such as insurance or financial companies. Significant resources were invested in building an internal sales force that acted as consultants as a way to sell equipment, software, and services. Over time these practices, beliefs, and values became institutionalized across the organizational field and formed into institutional logics. Influenced by higher-level societal institutional logics formed during the post-World War II period that emphasized centralized planning and technological advancements, the institutional logics of the mainframe era became dominant within the computer industry. Using the same framework created through Thornton & Ocasio (2008) and Friedland & Alford (1991) definition of institutional logics, Table 2 identifies the critical elements of this logics.

-------------------TABLE 2 ABOUT HERE---------------------

The introduction of the minicomputer

Digital Equipment Corporation's minicomputer, the PDP-1, was much smaller and less powerful compared to the mainframe but was more interactive and significantly less expensive. Instead of requiring its own temperature controlled room and a staff of computer specialists, the minicomputer could be located anywhere in the factory, scientific laboratory, or office and required only the expertise of an advanced user. Minicomputers initially found a market within the scientific and engineering community, and it was not unusual for engineers and scientists to learn how to program their minicomputer. This innovation led to great success for Digital Equipment Corporation and the market for the minicomputer expanded to the business world and signaled a radical change in computing (Earls, 2004). With growing adoption, both the minicomputer market and Digital Equipment Corporation experienced considerable growth through the 1970s. The company went from $188 million in annual sales with 7,800 employees in 1972 to just over $1 billion in sales with 36,000 employees in 1977 (Earls, 2004). Its rise was meteoric. Digital Equipment Corporation would grow to $14 billion in revenue by 1990 and over 120,000 employees, making it the largest minicomputer manufacturer and second largest overall computer manufacturer in the country. The growth and success experienced by Digital Equipment Corporation were seen not only as a validation of its strong technological and engineering capabilities, it was a validation of its organizational logics' consistency and compatibility of the broader dominant institutional logics of the mainframe era.

The emergence of the personal computer

Digital Equipment Corporation continued to improve its minicomputer product line and in the mid-1970s introduced its new state-of-the-art technology—the VAX minicomputer. Roughly the same time, Steve Jobs and Steve Wozniak introduced their first personal computer,

called the Apple II. Targeted to the computer hobbyist and home user, the personal computer, like the minicomputer before it, was considered a discontinuous technological change. But culturally and cognitively, the personal computer represented something very different. The mainframe and minicomputer originated from the military-industrial-academic complex with a culture of centralized planning and control. Computing was thought of as large transactional and data processing applications as well as sophisticated scientific and engineering applications. The technological design was important and needed to be protected. Mainframe and minicomputers were also high-margin products and with the proprietary nature of the technology, they were sold and serviced by the manufacturer. The personal computer, on the other hand, originated from the hobbyist and hacker culture and represented decentralized individual-centric computing. Its initial target market was individual hobbyists, home users, and small professional businesses. While the performance of the personal computer was significantly less than mainframe and minicomputers, it was good enough for its target market and, most importantly, its price made the product accessible.

While the price of a personal computer was significantly less than mainframe and minicomputers, so were its margins. The practice of mass production and mass marketing was adopted as a way to build market share in order to compensate for low margins. A new distribution system emerged, involving retailers, to support its mass distribution. What was perhaps the most significant about this technological change was not necessarily the technology. Most incumbent mainframe and minicomputers had the means of developing personal computers and did. What became significant was the shift of the institutional context and dominant institutional logics. The industry shifted from logics of the mainframe/minicomputer era to logics of the personal computer era. Table 3 summarizes this distinction.

-------------------TABLE 3 ABOUT HERE---------------------

The IBM PC

Institutional change is precipitated by significant events that jolt and destabilize an organizational field (Hinings et al., 2004). But events do not carry any independent or objective meaning. They require actors to pay attention, interpret, and make meaning (Meyer, 1982). In other words, jolts are socially constructed (Munir, 2005). Incumbents interpret and then respond in ways that can shape and influence the jolts and subsequent institutional change. In the technological change of the personal computer, one particular incumbent, International Business Machines (IBM), interpreted and responded is such a way that dramatically influenced this shift of the field's dominant institutional logics.

Up to this point in time in the industry's history, IBM was the largest computer manufacturer in the world. Originally a mainframe manufacturer, IBM initially ignored the emergence of the minicomputer but was able to recover and become a strong competitor in the minicomputer market. Recognizing that computing was evolving towards smaller machines and perhaps motivated by an earlier mistake when they first ignored the minicomputer (Metz, 1981; Pollack, 1981), IBM moved quickly to enter the personal computer market and in 1981 introduced its new personal computer called the IBM PC. Priced at around $1,500, the IBM PC was designed for businesses, schools, and homes. In addition, IBM offered a library of optional software as well as the BASIC programming language so software developers and organizations could create their own computer software application.

With its size, legitimacy, success, and power, IBM had the resources to legitimize the personal computer with organizations. The challenge for IBM was its bureaucracy, which would

make it difficult for them to build a personal computer quickly enough to compete with the growing personal computer manufacturers. One analyst was quoted as saying, "IBM bringing out a personal computer would be like teaching an elephant to tap dance" ("The birth of the IBM PC," n.d., para. 3). To counteract its own bureaucracy, a task force group was established outside of IBM's hierarchy and was challenged to build a personal computer within 12 months. IBM had never built anything in 12 months, so in order to meet this challenge, the task group decided to open its computer design and architecture to other companies as a way to speed the development of components and software[1]. Most significantly, IBM outsourced the two most critical components of the personal computer, the operating system, and microprocessor. The operating system was outsourced to a then relatively unknown company called Microsoft and the microprocessor was outsourced to Intel. This move would reshape the central source for achieving a competitive advantage as IBM relied, not on its engineering capabilities, but on its mass marketing capabilities.

Digital Equipment Corporation's response

Digital Equipment Corporation first reacted to the IBM PC as underwhelmed by its design and technology. It believed it could build a technologically superior personal computer and committed significant resources to do just that. Given Digital Equipment Corporation's success under its existing dominant organizational logics, focusing on the performance of proprietary technology seemed to make sense. The personal computer became Digital Equipment Corporation's central product strategy and in 1982 introduced not one, but three lines of personal computers, the Rainbow 100, DECmate II, and the Professional Series ("Digital to Offer New Products," 1982). At this point, IBM's decision to open its architecture and outsource software and components led to the emergence of industry standards that allowed any manufacturer to

build IBM PC compatible personal computers or IBM PC clones. By doing this, personal computer manufacturers were assured of becoming part of the ecosystem, providing access to a mass market committed to its open computing architecture. The institutional context and its dominant institutional logics were beginning to shift. Digital Equipment Corporation responded by utilizing its existing proprietary PDP minicomputer technology to build its personal computer ("Digital to Offer New Products," 1982). With this response, Digital Equipment Corporation rejected this shift and continued following its existing organizational logics rooted in the institutional context of the mainframe/minicomputer era. While this resulted in what was widely considered technologically superior personal computers, it left consumers and analysts confused. Why was Digital Equipment Corporation building personal computers incompatible with industry standards? Digital Equipment Corporation found itself on the outside of a shifting institutional context and its new personal computer lines never gained any market traction.

Unable to make any inroads in the personal computer market, Digital Equipment Corporation began to experience a significant decline in earnings (Laberis, 1982; "DEC profits Fall 36%, First Drop in Seven Years," 1982; Pollack, 1983a; Pollack, 1983b). This did not deter Olsen who saw it as a temporary setback and predicted that Digital Equipment Corporation's real problem would be meeting a highly anticipated demand of their new personal computers (Laberis, 1982). This never occurred. As a response, the company decided to move back to its VAX minicomputer technology as part of a strategy to move into a growing office automation market ("DEC Shows Its Colors in Traveling Road Show," 1982). This move was meant to boost demand for its VAX minicomputer and find a market for its personal computers. Digital Equipment Corporation entered a crowded office automation market with more than 300 competing companies (Dooley, 1982). IBM also entered this market and quickly became a

market leader with its PCs. The shift in the industry's institutional context continued to grow, but Digital Equipment Corporation continued to resist.

Digital Equipment Corporation continued to experience financial problems. In January 1992, the company reported a quarterly loss of $138 million ("Digital has Large Loss in Quarter," 1992), the next quarter it reported a quarterly loss of $234 million, and the next quarter a $294 million loss ("Digital Posts Huge Deficit," 1992). Finally, in the last quarter of the 1992 fiscal year, Digital Equipment Corporation reported a staggering $1.85 billion quarterly loss (Rifkin, 1992a). For the entire fiscal year, the company lost $2.8 billion. In addition to its lack of success in the personal computer market, Digital Equipment Corporation was experiencing a sharp decline in sales of its minicomputers. A fundamental shift was occurring from the institutional logics of the mainframe/minicomputer era to the logics of the personal computer era. Analysts and consumers became increasingly confused as to what business Digital Equipment Corporation was going to be in over the next five to ten years (Rifkin, 1991). The demand for its core product line, the minicomputer, had fallen dramatically over the years and there was a sense of disarray at the company's highest levels (Rifkin 1991).

A reluctant adoption

Digital Equipment Corporation eventually decided to make a shift and develop personal computers compatible with the IBM PC design. But this decision appeared to come too late. Ken Olsen stepped down as CEO and was replaced by vice president of manufacturing, Robert Palmer, who moved quickly to cut costs through massive layoffs, diversification of assets, and organizational restructuring. Palmer also returned the company to its original organizational logics centered proprietary technology. He focused on the introduction of a new microprocessor technology called Alpha. The Alpha was an ultra-fast microprocessor, exponentially faster than

all competitors' including market-leader, Intel. Digital Equipment Corporation, once again, demonstrated that it could develop new technology better than most ("Digital Introduces an Advanced Chip," 1992; Rifkin, 1992b), but this time it tried to borrow a page from IBM by attempting to create new industry standard through of licensing of the Alpha technology. While early partnerships were created, these partnerships did not last very long. Digital Equipment Corporation never achieved strong adoption for its Alpha technology and in April 1997, Digital Equipment Corporation reported a 50% drop in quarterly profits. Demand for Alpha technology was shrinking (Zuckerman, 1997).

The failure of the Alpha technology proved to be Digital Equipment Corporation's final act. On January 26, 1998, Compaq Computer Corporation agreed to buy Digital Equipment Corporation for $9.6 billion in cash and stock. It was the largest takeover in the computer industry at that time (Hansell, 1998). This acquisition represented the shift in the institutional context that occurred in the computer industry, a shift Digital Equipment Corporation resisted despite its ability to adapt to the technological change. Compaq Computer Corporation was at the time the largest personal computer maker in the world and had just acquired the largest minicomputer company.

Analysis of Digital Equipment Corporation's Failure

This article now turns to an analysis, using institutional change and institutional logics, to explain its failure. Given that institutional logics can be viewed as a multi-layered, interdependency between levels will emerge (Friedland & Alford, 1991). Organizations are both influenced and influence field-level logics, which then shapes changes of an industry's dominant institutional logics. In the case of Digital Equipment Corporation, development of the minicomputer was done within the existing dominant mainframe era institutional logics. While

the minicomputer may have been a discontinuous and disruptive technology change, it had minimal impact on the field's existing dominant institutional logics. The fundamental problem for incumbents became adapting to new technology. Even if incumbents initially ignored the technology change, it is reasonable to expect that by using their legitimacy, power, and resources accumulated within the existing institutional context that these incumbents would be able to catch up and even surpass the first-movers of technology change. This explains why mainframe market leaders, like IBM, were able to make up significant market ground and become strong competitors after being caught off-guard by the discontinuous change. A 1983 survey of the top 20 minicomputer manufacturers included six mainframe manufacturers, including IBM as the third largest minicomputer manufacturer (Henkel, 1983).

The personal computer, on the other hand, represented a divergent change of the institutional context and a shift of the dominant institutional logics. Digital Equipment Corporation, while adapting to the technological change of the personal computer, did so within the institutional context formed during the mainframe and minicomputer eras. Its organizational logics became incompatible with the changing field-level logics. This suggests that the degree of risk for incumbents facing technology change is influenced not so much by the technology change, but by the degree of change to the dominant institutional logics.

Hinings et al. (2004) point out that divergent change in the form of environmental jolts will lead an organizational field into a period of destabilization, creating opportunities for new dominant institutional logics to emerge. This places significant pressure on incumbents to respond to not only technology change but logics change. But as Munir (2005) points out, environmental jolts are socially constructed and require interpretations by incumbents to form meaning. How an incumbent responds to such jolts is largely influenced by its own

organizational logics. This becomes a significant challenge for incumbents. They must find a way to interpret and respond free from its own institutionalized organizational logics. A comparison of responses by IBM and Digital Equipment Corporation bear this out.

Why IBM and not Digital Equipment Corporation

Comparing IBM and Digital Equipment Corporation during this period provides insight into how incumbents might avoid failure like Digital Equipment Corporation. Both IBM and Digital Equipment Corporation were formed during a period where the institutional context was dominated by the institutional logics of the mainframe and minicomputer era. So, why was IBM able to dominate, for a period, the new personal computer market while Digital Equipment Corporation failed? Tushman and O'Reilly (1996) argues that organizations evolve through periods of incremental change dominated by mature technologies that is then punctuated by periods of revolutionary or discontinuous change dominated by new technologies. They further argue that organizations need to be ambidextrous in exploiting mature technologies through efficient incremental change while also exploring new technologies through flexible experimentation. This is difficult for any organization but particularly difficult when discontinuous change represents both a shift in technology and the industry's dominant institutional logics. Existing mainframe manufacturers were able to meet the challenge of minicomputer because the challenge was limited to technology. The personal computer, on the other hand, represented a shift in technology and dominant institutional logics. Digital Equipment Corporation was able to meet the challenge of the technology change but did not respond to the shift in dominant institutional logics. IBM responded respond to both. To understand why requires, as Tushman and O'Reilly (1996) argued, a look inside each firm at the key decisions that were made.

IBM interpreted and responded to the emergence of the personal computer by creating a task force outside its existing organizational structure and logics. This was largely done as a way to shrink development time. Unencumbered by institutionalized pressures both at the industry and organizational level, the task group was also able to break from IBM's existing dominant logics to innovate and change both the technology and institutional logics. The task group was able to engage with outside vendors to develop components and applications. The shift in the dominant institutional logics from a closed to open computer design led to the creation of a new ecosystem and then into industry standards. IBM addressed not only the technology but also the institutional context.

Digital Equipment Corporation's interpretation and response focused exclusively on the technology and not the broader institutional context. When faced with the challenge of IBM's new personal computer, Digital Equipment Corporation saw its solution as building a technologically superior computer. The company was organized as a product-management matrix structure with its operating committee acting as internal venture capitalists, listening to project proposals and deciding on funding. This structure appeared to contain the same level of autonomy as IBM's personal computer task group. Digital Equipment Corporation's product managers were free to pursue projects with little constraints other than securing internal resources and funding.

Digital Equipment Corporation's product-management matrix structure provided so much autonomy that more than one product development team emerged to compete with each other in developing a personal computer. This represented a significant investment by Digital Equipment Corporation and, as Ken Olsen commented, a competitive internal market process that would maximize innovation. But two problem emerged. The first was the strategic confusion caused by

multiple product development teams independently pursuing the personal computer. Not only was this confusing for employees, it was confusing for consumers. The result was three different personal computer product lines, each incompatible with each other. The second problem was that even with such autonomy, it was still within the existing organizational structure. This meant that product managers and product teams still operated within the context of the Digital Equipment Corporation's existing dominant logics, which was aligned to the institutional logics of the mainframe and minicomputer era but not to the personal computer era.

Implications for Practice

This comparison between IBM and Digital Equipment Corporation raises several implications for practice. Organizations when faced with technology change must be sensitive to the possible impact that change has on the broader organizational field and institutional context. To shift this perspective, organizations need to engage in problem-solving rather than just decision-making. Problem-solving involves choosing appropriate issues and framing a situation in a way that may challenge existing assumptions and cognitive biases in order to identify novel possibilities, while decision-making is choosing the best possibility (Bhardwaj, Crocker, Sims, & Wang, 2018). Digital Equipment was able to make decisions but unable to properly frame and reframe the problem.

Another implication for practice relates to organizational structure. Organizations may be better served addressing institutional change outside of its existing organizational structure. Tushman and O'Reilly (2002) point to autonomous business units as part of an organization's structural design to foster exploration and innovation. This may not be enough. Digital Equipment Corporation had a structure that allowed for autonomy but still could not overcome

the organization's existing logics. IBM, on the other hand, created a task force completely outside its organizational structure.

While an internal market structure, where managers are free to pursue ideas and compete with each other for corporate resources, may seem like an efficient and agile way to innovate, it can lead to confusion both internally and externally. IBM created the strategic mandate for a single task group to operate outside of its structure. Digital Equipment Corporate created a structure that allowed its product managers to operate as entrepreneurs, which led to confusion and incompatible product lines.

Finally, organizations must understand the innovation occurs not only at the organizational level but also at the institutional level. Institutional innovation may provide a significant opportunity for organizations to reshape itself and its industry.

Conclusion and Future Research

This case demonstrates that organizational failure during periods of technological changes may not be the direct result of technology. Organizations can adapt to technology change and still fail. This can occur when technology change causes a shift in the dominant institutional logics of the organizational field. Digital Equipment Corporation adapted to the technology change brought on by the emerging personal computer but resisted the broader changes in the institutional context. This suggests that focusing on technology change may not be enough. But this study focused on a single organization, which makes it difficult to draw generalizations. More case studies are needed using institutional analysis to better understand organizational failure. Also, while this study suggests what organizations might do to avoid failures like Digital Equipment Corporation, more research is needed in drawing further and more detailed implications for practice.

NOTES

1. In 2007, Apple Computer, Inc. removed "Computer" from its name. This change was representative of its shift from a computer company to a consumer electronics company.

2. This move actually led to a new market of IBM compatible personal computers (or IBM clones), which by the 1990s eroded any advantage IBM have in this personal computer market. Compaq Computer, Inc., the market leader of the personal computer by the mid-1990s was created to build and market IBM clone personal computers.

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Table 1

Dominant Organizatonal Logics of Digital Equipment Corporation

Components of Institutional Logics	Organizing Principles
Symbolic Construction: Culture & Cognitive Structures	Culture • Rooted in co-founder Ken Olsen's early experience in a large Industrial-Military-Academic research organization • Paternal organization: differences, conflict, and open-debate is encouraged • Individual freedom to do the right thing Cognitive Structure • Competitive advantage comes from technical and engineering excellence • Well engineered products will sell themselves • Computing was for scientific and business organizations, not individuals
Material Practices	• Engineering-centric organization where engineers' ideas were privileged and prioritized • Closed and proprietary computer design • High-quality operation driven by strong research & development • Centralized minicomputers designed for science and business applications • Very limited marketing • Internal market using product-management matrix structure

Table 2.

Logics of the mainframe and minicomputer era

Components of Institutional Logics	Organizing Principles
Symbolic Construction: Culture & Cognitive Structures	Culture • Rooted in the centralized Military-Industrial-Academic complex culture Cognitive Structure • Growth comes through direct sales and service to large organizations. • Increased profit comes through high-priced, high-margin product lines • Competitive advantage comes through technical and engineering designs
Material Practices	• Central products were mainframe and minicomputers designed for centralized computing for large companies • Compete on closed and proprietary computer design • Centralized manufacturer sales force focused on consultative sales • Sales and distribution direct from manufacturer

Table 3

A Shift in Dominant Institutional Logics in the Computer Industry

	Organizing principles of the mainframe/minicomputer era	Organizing principles of the personal computer era
Symbolic Construction: Culture & Cognitive Structures	Culture • Rooted in the centralized Military-Industrial-Academic complex culture Cognitive Structure • Growth comes through direct sales and service to large organizations. • Increased profit comes through high-priced, high-margin product lines • Competitive advantage comes through technical and engineering designs • Closed system architecture	Culture • Rooted in the Hobbyist and Hacker culture Culture Structure • Growth through economies-of-scale and mass-marketing. • Increased sales through low-priced, low-margin product lines. • Competitive advantage comes through compatibility and marketing • Open system architecture
Material Practices	• Central products were mainframe and minicomputers designed for centralized computing for large companies • Compete on closed and proprietary computer design • Centralized manufacturer sales force focused on consultative sales • Sales and distribution direct from manufacturer	• Central product was the personal computer designed for individual users • Created open and nonproprietary computers that adhere to Wintel industry standards • Mass-marketing • Distribution through manufacturer and retailers