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Implementing Disruptive Technologies: What Have We Learned?

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Abstract:

Rich research opportunities lie ahead for scholars interested in building a theory to explain why and how some organizations succeed while others fail in implementing disruptive technologies. As a complex socio-technical process, implementing disruptive technologies represents an endeavor fraught with challenges. Leaders need tools to assess whether implementing a potentially disruptive technology will succeed or fail; planners need a road map to navigate the implementation's potential stepping-stones and stumbling blocks. Disruptive technology implementation scholarship is rich, has eclectic roots and conflicting findings, but lacks a success theory. To advance such a theory and guide scholars and practitioners, we conducted a structured and systematic literature review, and examined 139 empirical articles published between 1983 and 2020 in leading management and information systems journals. We focused our attention on answering two questions: How do incumbent organizations implement disruptive technologies successfully? How does the implementation of disruptive digital technologies differ from the implementation of other disruptive technologies? We employed a mixed-method approach using three criteria: technological category, challenges to successful implementation, and degree of implementation success. We identified strategic and technical implementation challenges, developed a technology implementation framework, and advanced propositions that together provide a current disruptive technology implementation success theory pending further testing.

Keywords: Disruptive Technology, Digital Technology, Information Technology, Implementation, Challenge, Enablers, Success, Literature Review.

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1 Introduction

Both practitioner and academic studies inform us that incumbent organizations struggle to translate their endeavors to implement disruptive technologies into effective products and services that deliver desired business value (e.g., Kappelman et al., 2021; Kappelman et al., 2018). Organizations often spend too much money on efforts to implement technologies that fail, and business leaders are frequently frustrated trying to get great results from these efforts. The failures and frustration have not gone unnoticed by academic scholars. Management researchers have extensively studied the impact of disruptive technologies on organizations (e.g., Christensen et al., 2018; Danneels, 2004). In the information systems literature, Vial (2019) for example, conducted an extensive literature review and concluded that gaining a better understanding of the challenges associated with disruptive technology implementation would inform both researchers and practitioners. Our main objectives in this research are to understand the challenges faced by organizations implementing disruptive technologies, and to provide guidance on how to assess the success of these implementation efforts.

Disruptive technologies are conceptualized using many perspectives including the replacement of incumbents by entrant firms, the market adoption of disruptive technologies, and the firms implementing these technologies (Christensen et al., 2018; Danneels, 2004). In this paper, we distinguish between disruptive and non-disruptive technologies based on whether an implemented technology represents competence-enhancing or competence-destroying changes within the implementing organization (Tushman & Anderson, 1986). This is a resource or competence-based perspective assuming that a firm's objective of implementing any technology is to enhance competence. Consequently, we follow Danneels (2004, p. 248) and define disruptive technologies as "those technologies that render established technologies obsolete and therefore destroy the value of the investments that incumbents have made in those technologies."

Technologies implemented in organizations are not inherently disruptive (Danneels, 2004). Thus, when incumbent organizations implement new technological improvements that extend and build on previous technologies, they generally make incremental or sustained (non-disruptive) improvements. In contrast, when organizations implement technologies that fill a void (e.g., enterprise resource planning systems, e-commerce) or completely replace old but different technologies (e.g., computer-aided design or manufacturing), they enter the realm of disruptive technologies (Christensen & Bower, 1996). Consequently, disruptive technologies are new and unproven to the implementing firm, lack refinement, challenge existing organizational norms and routines, and hence appeal to a limited audience. No wonder, then, that implementing disruptive technologies comes with challenges. For decades, scholars have examined the implementation of different technologies and found many persistent challenges. In this study, we take all recorded sources of challenges into consideration.

We focus our attention on incumbent rather than entrant or startup organizations. Incumbent (also referred to as established) firms, those already in the industry (Dyer et al., 2020), differ from entrant and startup firms in several key aspects closely associated with the challenges encountered when implementing disruptive technologies (Christensen et al., 2018; Danneels, 2004). Incumbent firms are typically well-established firms with mature or optimized processes, routines, and technologies serving a specific sector of the market. Incumbent firms have management and employees experienced in existing technologies and often prefer to incrementally sustain them. Entrant firms can be either established or startup organizations attempting to enter new or adjacent sectors of the market by implementing disruptive technologies. Some established organizations act like startups and become new entrants to new sectors of the market by creating autonomous organizational units and tasking them with developing and implementing disruptive technologies (Christensen et al., 2018).

Consequently, startup firms and entrant firms, with autonomous units focused on new markets, are outside the scope of this research. Such firms can experiment with disruptive technologies unshackled by sunk cost or an existing management and a workforce wedded to prior technologies (Eggers & Park, 2018; Lavie, 2006). While incumbent organizations stand the chance to succeed or fail when implementing disruptive technologies, entrants "have less to lose, and for them a disruptive technology may be the only chance to gain a foothold" (Danneels, 2004, p. 250). Thus, the challenges are more profound for incumbent (established) firms that tend to struggle with disruptive technology implementation.

Recently, we entered the sixth wave of technological disruption—digital disruption. This wave comes after the 'water power and iron' wave, the 'steam power and railways' wave, the 'steel and electric power' wave, the ‘automobile and oil’ wave, and the ‘computers, telecommunication, and information technology’ wave (Bodrožić & Adler, 2018). But what is digital disruption? Digital disruption alters the dominant established logic, norms, or routines of an organization where the novelty of digital objects and their digital attributes give rise to innovations (Baiyere & Hukal, 2020). Our research also aims to examine whether the implementation of disruptive digital technologies leads to different challenges when compared with other disruptive technologies.

Scholars have studied how incumbent organizations have implemented many disruptive technologies, whether digital or non-digital, and have produced a rich body of knowledge that needs to be classified and integrated to draw a holistic picture of the challenges associated with implementing disruptive technologies. This body of knowledge has eclectic roots that complicate any attempt at creating a comprehensive model of the challenges. Scholars in the information systems field rarely use the term disruptive technology explicitly when studying the implementation of information systems and technologies in organizations (e.g., Baiyere & Hukal, 2020; Kohli & Melville, 2019; Vial, 2019). In contrast, strategy and management scholars often use the term disruptive technology to describe a wide range of technologies from biotechnology to MRI machines (e.g., Danneels, 2004; Eggers & Park, 2018; Lavie, 2006).

The information systems literature describes digital technologies (including information technologies) as inherently disruptive (Karimi & Walter, 2015). This literature articulates three types of disruptions: altering consumer behavior and expectations, disrupting the competitive landscape, and increasing the availability of data (Vial, 2019). None of these types of disruptions are directly concerned with the challenges facing organizations while implementing these technologies. Strategy and management scholars have been more concerned with what makes a technology disruptive from a market perspective and have focused their attention on the ultimate success or failure of firms implementing these technologies. Other scholars have also been concerned with the methods used to predict whether a specific technology becomes disruptive (Danneels, 2004). One question the strategy and management literature has not answered is “What determines whether incumbents fail or succeed in the face of disruptive technology?” (Danneels, 2004, p. 252).

The disruptive innovation literature (Christensen et al., 2018) has been mainly concerned with the success and failure of incumbent organizations taking a retrospective approach. This literature offers several explanations for overall incumbent failure and why some entrants succeed while incumbents fail. These explanations revolve around the resource allocation process, and organizational resources, processes, and values (Danneels, 2004). For example, entrant firms unburdened by existing skills, abilities, and expertise related to prior technologies have a better chance of succeeding while implementing disruptive technologies (Tushman & Anderson, 1986). Scholars often assume that “prior experience, and the routines and competencies built from it, reduce the adaptability of organizations faced with technological shifts.” This view has been challenged and several other explanations have been provided for the success and failures of both incumbent and entrant organizations faced with disruptive technologies (Danneels, 2004, pp. 252–255).

Great efforts have gone into understanding how organizations reconfigure their capabilities (Lavie, 2006) and adapt (Eggers & Park, 2018) to technological disruption. Furthermore, the retrospective examinations of the impact of disruptive technologies on the market, and the success and failure of firms, have produced some insights related to the implementation challenges. These insights continue to be fragmented and often focused on the firms’ resources (Danneels, 2004; Eggers & Park, 2018; Lavie, 2006). Taking a different approach, some scholars have examined success factors associated with implementing information systems in a specific sector of the industry—for example, healthcare (e.g., Berg, 2001). Other scholars have examined classic mistakes and best practices in failed information technology projects (e.g., Nelson, 2007). Yet other scholars have examined users’ resistance (Lapointe & Rivard, 2007) or implementers’ responses to that resistance (Rivard & Lapointe, 2012). Consequently, scholars often examine technology implementation from a narrow perspective and underestimate the challenges. To the best of our knowledge, no one has conducted a comprehensive study of the challenges associated with implementing disruptive technologies in organizations.

There are two benefits to studying the challenges to disruptive technology implementation in organizations: theoretical and practical. First, the field lacks a comprehensive theory that addresses disruptive technology implementation challenges. None of the existing theoretical frameworks explain why some organizations struggle or even fail while implementing disruptive technologies but others succeed. Furthermore, none of the existing theoretical frameworks provide predictions or describe the necessary elements that must be considered to avoid such struggle or failure. Distinctions among different categories of disruptive technologies are nonexistent. Finally, there is no consensus in the literature regarding what constitutes success in any disruptive technology implementation endeavor.

Second, organizational leaders and consultants need help navigating the myriad of challenges facing organizations while implementing disruptive technologies. Can the lessons learned during the implementation of prior technologies be helpful or detrimental to implementing new technologies? In other words, should all types of disruptive technologies be considered equal, or does each come with different challenges? Practitioners struggle to identify when an implementation project must be terminated instead of pouring out additional funds and resources to get it done, and when they can consider it to be a success story. They also struggle to plan for all the possible roadblocks that stand in the way of delivering the desired benefits (e.g., products and services) intended from the implementation of disruptive technologies.

This research addresses theoretical and practical gaps by answering the following two research questions:

RQ1. How do incumbent organizations implement disruptive technologies successfully?

RQ2. Does the implementation of disruptive digital technologies differ from that of other disruptive technologies?

To answer these questions, we conducted a structured and systematic literature review (Webster & Watson, 2002). We reviewed and coded 139 empirical articles published in the information systems and management literature. The coding criteria included the category of disruptive technology, the challenges organizations face when implementing it, and the degree of implementation success. In the process, we developed a taxonomy for types of disruptive technologies. We also developed a comprehensive framework that classifies both internal and external technology implementation challenges. Finally, we propose a theory for disruptive technology implementation success in organizations. Our technology implementation framework (TIF) provides a guide for practitioners involved in implementing disruptive technologies and a tool for scholars exploring the topic.

Our paper proceeds as follows. In the following section, we cover important conceptual foundations necessary to understand the challenges associated with implementing disruptive technologies. Following this, we introduce our TIF and discuss some of the challenges. Then, we describe our research methodology and provide sample coding. We next present our study findings. We provide details about the challenges of implementing disruptive technologies, discuss the uniqueness of digital technologies, and propose a disruptive technology implementation success theory. We conclude the article after the Discussion of Findings section.

2 Conceptual Background

2.1 Disruptive Technologies

Scholars agree that technology disruption can represent a matter of life and death to incumbent organizations (Danneels, 2004). According to Lucas et al. (2013, p. 380), “organizations are confronting disruptive technology every day, and may well be forced into bankruptcy if they are unable to respond to innovators using new technology and processes.” Consequently, firms implement new technologies to capture business opportunities, maintain or improve efficiency and market share, and stay current with rapidly changing technologies (Fitzgerald et al., 2014; Furr & Shipilov, 2019).

Christensen and Bower (1996) distinguish between sustaining and disruptive technologies. Sustaining technology builds on existing technology and relies on incremental improvements to that technology. In contrast, disruptive technology is new (at least to the implementing organization), lacks refinement, and may not have proven its usefulness. Hence, it appeals to a limited audience. Consequently, sustaining technologies have a sustaining impact on an established trajectory of performance improvement in existing processes, procedures, methods, and materials used to achieve commercial or industrial objectives. Disruptive technologies, in contrast, disrupt an established trajectory of performance improvement or redefine what performance means. As a result, many technologies qualify as being disruptive using these criteria. Furthermore, any technology can be either sustaining or disruptive depending on the context and on how it is implemented (Danneels, 2004).

Table 1. Categories of Disruptive Technologies

Category	Definition	Examples
Digital Technologies Faulkner & Runde (2019), Vial (2019)	Tools and systems that employ digital objects over the Internet to provide distributed or remote organizational resources	Cloud computing, digital platforms, software as a service, social media, search engines, online expert systems, Blockchain
Function IT McAfee (2006)	IT that assists with the execution of discrete tasks	Simulators, spreadsheets, computer-aided design, and statistical software
Network IT McAfee (2006)	IT that facilitates interactions without specifying their parameters	E-mail, instant messaging, blogs, mashups, IT networking infrastructure, Internet & intranets, conferencing tools (e.g., Zoom, MS Teams)
Enterprise IT McAfee (2006)	IT that specifies business processes	Enterprise resource planning, customer resource management, and supply chain management
Traditional (Non-IT) Eggers & Park (2018), Lavie (2006)	Physical and material objects and tools that can convert inputs (materials, labor, capital) into outputs to achieve commercial or industrial objectives	Biotechnology, microchips, flat panel displays, fiber optics, MRI machines, digital cameras, scanners, smartphones

The literature does not have the clear set of criteria needed to distinguish among various types of disruptive technologies. Thus, we developed a taxonomy considering three aspects: ontology, nature of interaction, and existing classifications in the literature. First, we examined the ontology of the technologies being studied. For example, whether the technology is a software package that can be installed on a single computer, or MRI machines implemented in a hospital. Second, we considered how the implemented technology changes the nature of interaction among users within an organization. An enterprise resource planning system changes the nature of interactions among various departments and units (Alvarez, 2008). In contrast, computer-aided design software installed in an engineering department has little impact on the nature of interactions between engineering and other departments (Klein & Sorra, 1996; McAfee, 2006). Finally, we considered the existing identification of certain technologies. For instance, McAfee (2006) distinguished among three types of information technologies and we adopted his categorization of these technologies even though we identified limitations (Faulkner & Runde, 2019; Kallinikos et al., 2013).

Based on the above criteria, we grouped various technologies into five categories: digital technology, function IT, enterprise IT, network IT, and traditional (non-IT) technologies. The category of traditional technologies includes a collection of technologies that do not fit well in any of the other categories. These traditional (non-IT) technologies have frequently appeared in the management and strategy literatures. Table 1 provides definitions and examples of the five categories of disruptive technologies used in this study.

But do digital technologies differ from other disruptive technologies, and if so, how? Many scholars consider digital technologies to be objects of a different breed. Faulkner and Runde (2013) define digital technologies as distinct objects that are not spatial and possess a nonphysical mode of being. Kallinikos, Aaltonen, and Marton (2013) argue that digital technologies have an ambivalent ontology, and they differentiate digital from traditional (non-digital) technologies based on four characteristics: editability, modifiability, interactivity, and distributedness. This ambivalent ontology stems from the realization that digital technologies are distinct objects, but these objects "lack the plenitude and stability afforded by traditional items and devices" (Kallinikos et al., 2013, p. 358). These objects lack plenitude because they are never full or complete; rather, they are continually being modified and changed. Similarly, digital objects lack stability because it is easy to transfer these objects and use them in different forms or for different purposes.

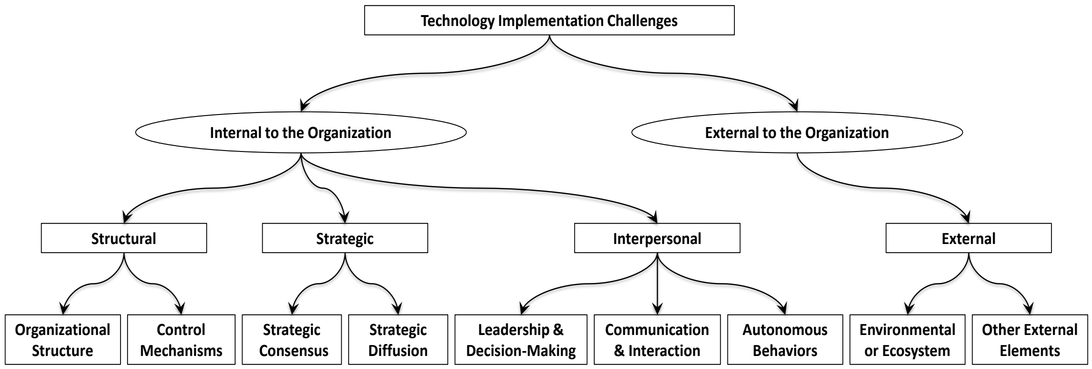

Figure 1. Technology Implementation Framework (TIF)

Consequently, it is important to examine whether implementing disruptive digital technologies differs from implementing other non-digital technologies. Furthermore, Baiyere and Hukal (2020) argue that for digital technologies to be disruptive, two innovations must take place: disruptive innovations and digital innovations. Disruptive innovations make one entity (e.g., product, process, service, or business model) obsolete by replacing it with a new entity (Govindarajan & Kopalle, 2006). Digital innovations are new products, processes, services, or business models that require significant changes by adopters and are embodied in or enabled by IT (Fichman et al., 2014). Digital technologies may or may not be disruptive. In the following section, we discuss the challenges associated with implementing disruptive technologies.

2.2 Implementation Challenges

Implementation is a process intended to turn an initiative into action assignments to accomplish stated objectives. This initiative can be a project, plan, technology, or strategy. Consequently, implementation is the act of executing, performing, carrying out, or turning an initiative into effect, use, completion, and fulfillment. In organizations, implementation often represents a series of interventions involving organizational structure, personnel actions, and governance to direct performance toward desired ends (Noble, 1999). Different scholars have used conceptual windows of various sizes when studying implementation. That is, implementation can be viewed as a long continuum, and scholars choose a small window to look at one part of that continuum. For example, some scholars consider implementation to occur when the project is initiated whereas others consider implementation to be incomplete unless infusion occurs and the desired benefits are realized. Gottschalk (1999), based on a literature review, provides a list of 19 stages of implementation completion that range from installing a system to fully realizing the objectives. Cooper and Zmud (1990) outline a six-stage model of technology implementation: initiation, adoption, adaptation, acceptance, routinization, and diffusion. Similarly, Leonardi and Barley (2010) identify the technology implementation phases as perception, interpretation, appropriation, enactment, and alignment. Consequently, what we see in studies of implementation reflects the size of the conceptual examination window for the project or technology under investigation.

In our initial literature review, we identified numerous causes for technology implementation challenges and failures in organizations. We placed these challenges into two broad categories—internal and external—though these categories sometimes overlapped as the internal-external boundaries became blurred. The internal category comprises what organizations do internally to facilitate technology implementation and how they do it. The external category comprises environmental and market or organizational ecosystems. We further divided the internal challenges into three broad categories based on the nature of the challenges: structural, strategic, and interpersonal. Our final analysis resulted in nine general "leaf" or more granular elements representing unique determinates of technology implementation challenges in organizations, as shown in Figure 1.

The structural category is concerned with how managers make adjustments to formal, structural elements of the organization such as roles, reporting relationships, and control mechanisms. The strategic category is concerned with how managers create and implement the technology implementation strategy, and how they achieve consensus about a specific implementation project. The interpersonal category is concerned with interpersonal and cognitive factors or inhibitors that affect how managers make decisions and communicate before and during the implementation process. It is also concerned with how employees resist implementing new technology, and how leaders respond to that resistance. Table 2 provides details and references for the types of challenges associated with each of the elements identified in our TIF.

Table 2. Elements of the Technology Implementation Framework (TIF)

Category	Details and References
Organizational Structure	Structure of the business units; strategy-structure alignment (Kohli & Melville, 2019; Noble, 1999). Implementation processes' fit to organizational structure (Eggers & Park, 2018; Lavie, 2006). Structural changes resulting from changes in the business model (Noble, 1999; Vial, 2019). Adjusting organizational structure by creating separate or multidisciplinary units. Adjusting the degree of independence among existing and newly formulated units (Vial, 2019).
Control Mechanisms	Organizational formal control systems may be defined as a three-stage cycle (Daft & Macintosh, 1984) including (1) planning a target or standard of performance; (2) monitoring or measuring activities designed to reach that target; and (3) implementing corrections if targets or standards are not being achieved (Noble, 1999). Accounting-based control mechanisms (Hitt et al., 2017). Selective degrees of changes to the various control processes (Eggers & Park, 2018; Lavie, 2006). Limitation to managerial fiat (Kohli & Melville, 2019).
Strategic Consensus	Shared understanding and commitment to a strategic directive among individuals or groups (Noble, 1999). Managers' affective consensus depends on how the proposed technology implementation fits with what managers perceive as the best interests of the organization, and how it fits with managers' self-interests (Eggers & Park, 2018; Noble, 1999; Vial, 2019). Understanding of organizational culture and identity (Eggers & Park, 2018; Noble, 1999; Vial, 2019). Organizational memories of prior failures (Ngwenyama & Nielsen, 2014).
Strategic Diffusion	Implementation plans or objectives fail to trickle down from the top management team to the execution level (Noble, 1999; Svahn et al., 2017). Sponsors, adopters, firm-level factors, and the nature of the technology being implemented may all contribute to a lack of diffusion (Cooper & Zmud, 1990; Eggers & Park, 2018; Noble, 1999).
Leadership & Decision-Making	Delegation of authority, decision-making, driving agents, and planning processes (Noble, 1999). Organizational leadership climate—centralization, complexity, production, and efficiency (Kohli & Melville, 2019; Noble, 1999; Nutt, 1986; Vial, 2019). Top management characteristics and leadership styles affect whether and how a firm is open to technology implementation (Bourgeois & Brodwin, 1984; Eggers & Park, 2018).
Communication & Interaction	Vertical and lateral communication, obtaining broad-based inputs, and participation (Eggers & Park, 2018; Noble, 1999). Poor or inadequate information sharing among individuals or units responsible for technology implementation (Hrebiniak, 2006; Noble, 1999; Vial, 2019). Assessing the potential obstacles to implementation, making early and decisive moves in resource commitments, organizational structure, and reward mechanisms (Noble, 1999). Selling technology implementation to affected members, fine-tuning, adjusting, and responding as events arise (Noble, 1999). Enacting defensive routines and working around them (Kohli & Melville, 2019; Noble, 1999).
Autonomous Behaviors	Autonomous behaviors may result in resistance (passive compliance, upward intervention, and deliberate creation of barriers) to implementation (Noble, 1999; Vial, 2019). Members may not operate under the same goals and objectives and intentionally deviate from an implementation initiative to pursue their own desired ends (Lucas Jr & Goh, 2009; Noble, 1999; Schmid et al., 2017).
Environmental or Ecosystem	Environmental uncertainty and turbulence (Laumer et al., 2016; Martinez-Simarro et al., 2015). Ecosystem challenges, cohesion, and diversity (Snider et al., 2009). The pressure to implement in less than optimum time due to competition or some other external interventions (Brown, 1998; Guth & MacMillan, 1986). Availability of external resources in the ecosystem to overcome challenges associated with implementing technology (Canato et al., 2013; Stieglitz et al., 2016).
Other External Elements	Dependence on consultants (Berente & Yoo, 2012). Emergent change in practice (Kelly & Amburgey, 1991). Vendor-side challenges (Chan et al., 2011; Chanias et al., 2019). Technology characteristics (Polites & Karahanna, 2012).

Further examination of the internal challenges to technology implementation revealed similarities to some of the elements identified by Noble (1999) as influencing strategy implementation. Consequently, we followed Noble when categorizing the internal challenges and, for the most part, retained the names he used. However, we complemented our understanding of these elements and set their boundaries with findings from the strategy, general management, and information systems literatures to produce a comprehensive TIF. We referred to the technology implementation literature (see the following section) to identify and set the boundaries of the external challenges.

3 Research Methodology

We divide our research methodology into two sections. In the first section, we discuss the process we followed to create our research database and summarize each step used to create this database. In the second section, we discuss the review process. We detail the coding mechanism, create a concept matrix, and describe the general characteristics of the articles in our database.

3.1 Creating a Research Database

This literature review follows the systematic approach recommended by Webster and Watson (2002). Our main objective is to examine disruptive technology implementation in established organizations. Specifically, we focus on incumbent organizations and well-established entrant firms that do not have autonomous units devoted to implementing new or unfamiliar technologies—both types are considered incumbent in our study, and we refer to them interchangeably as established or incumbent. Thus, we are not examining technology innovation or technology implementation in entrepreneurial or start-up organizations. Furthermore, we are not limited to any specific technology as we recognize that examining different technologies may help us draw a more holistic picture of technology implementation. Table 3 outlines the steps followed to create our database. We provide details for these steps as follows.

3.1.1 Step 1: Identify a set of search keywords

Our research questions are: (1) how do incumbent organizations implement disruptive technologies successfully? (2) does the implementation of disruptive digital technologies differ from other disruptive technologies? To answer these questions, we create a database that includes articles addressing three broad areas: organizations, implementation, and technologies. The first area covers technology implementation in an organizational context, that is, an incumbent firm, company, or organization. The second area covers what organizations do with technology. For disruptive technologies, scholars often use the terms “implement”, “adopt”, “execute”, “adapt”, and “change”. Finally, the third area covers technologies being implemented. We did not limit our search to a specific technology. Hence, we retrieved articles that included all kinds of technologies: technology, information, software, system, digital, and disruptive.

Table 3. Outline of the Major Steps Taken to Create the Research Database

#	Objective	Details
1	Identify a set of search keywords	(incumbent *OR* firm *OR* company *OR* organization) *AND* (implement *OR* execute *OR* change *OR* disrupt *OR* adopt *OR* adapt) *AND* technology *OR* information *OR* system *OR* digital *OR* IS *OR* IT *OR* ICT)
2	Set the time frame and publication venue	Time frame 2010-2020 AIS basket of 8; Select number of management journals
3	Decide search engine and method	Use Web of Science, keywords, and journal by journal search
4	Create the database	Review the abstracts of the articles and create a list of relevant articles (to-keep list); Download relevant articles to a Zotero database
5	Do backward citation	Create another list of relevant articles from the references cited in each article in the database
6	Do forward citation	Use Google scholar to identify additional articles that cited the articles in the database

While the search keywords for the organizational context (incumbent, firm, company, organization) returned all types of organizations, we relied on reading the articles to exclude research not involving established (incumbent) organizations. Specifically, we excluded entrepreneurial and startup firms. Furthermore, while attempting to enter new or adjacent markets, some established organizations have created autonomous units dedicated to implementing or experimenting with disruptive technologies. These organizational units acted like entrepreneurial firms and hence were also kept out of our database. Finally, we also excluded research that examined technology implementation outside organizations.

We set three criteria for distinguishing between established firms and entrepreneurial or startup firms. First, an established (incumbent) firm has a specific and well-identified market segment. Second, an established firm has existing operations and routines to serve this market segment where the disrupting technology can change or uproot these operations and routines. Finally, the established organization is not experimenting with disruptive technology for entrepreneurial purposes—rather, the organization is committed to implementing specific disruptive technology to achieve given strategic goals.

Since our objective is to understand the challenges to implementing technology rather than the technology itself, our search criteria attempt to retrieve articles that discuss all kinds of technologies. In the information systems literature, the term disruptive rarely appeared. Instead, scholars examined systems like cloud computing, digital platforms, and enterprise resource planning (Table 1).

Articles that discussed sustaining (non-disruptive) technologies were excluded during the review and coding process (see Step 6, and the Review Process sections below). In deciding which articles to exclude, we carefully examined whether the context of the implementation indicated that the implemented technology had incremental or sustaining improvements to existing organizational routines and processes. In contrast, when the implemented technology was new (at least for the focal firm), changed the performance trajectory, destroyed existing competencies, and affected organizational processes and capabilities, then this technology was considered disruptive, and the article was retained for our final analysis. In other words, we closely followed the criteria set by Christensen and Bower (1996), Tushman & Anderson (1986), and Danneels (2004) as outlined in Section 3.1.

Consequently, we searched for articles that contain (Area 1) *AND* (Area 2) *AND* (Area 3) in the subject, keywords list, title, or abstract. Specifically, we used (incumbent *OR* firm *OR* company *OR* organization) *AND* (implement *OR* execute *OR* change *OR* disrupt *OR* adopt *OR* adapt) *AND* (technology *OR* information *OR* system *OR* digital *OR* IS *OR* IT *OR* ICT). We used an asterisk (*) to replace the letter or letters that represent the family of the word. For example, we used the word “compan*” to represent both company and companies.

3.1.2 Step 2: Set time frame and publication venues

Although the choice of search keywords is dictated by the research question and objective, the selections of a time frame and publication venue are arbitrary. Scholarly guides on how to write a literature review do not provide clear guidance on how to select a time frame and publication venue (e.g., Paré et al., 2015; Webster & Watson, 2002; Wolfswinkel et al., 2013). A wider time frame and a larger number of journals, conference proceedings, and books may increase the work-load of an already time-consuming project (Webster & Watson, 2002). A narrower time frame and a smaller number of publications may limit the generalizability of the results and lead to inconclusive findings. The two choices ultimately depend on the objective and scope of the research. Nevertheless, the choices of a time frame and publication venue represent two major limitations for any literature review. In Steps 5 and 6, we describe how we overcame these two limitations.

For our study, we set the time frame for the 10 years between January 2010 and January 2020. Because implementing disruptive technologies is not limited to information systems and technologies, we included both information systems journals and general management journals. We excluded articles published as part of books or practitioners’ journals because these articles are typically based on scholarly work published in other venues. Finally, we excluded conference proceedings and other types of publications.

In selecting information systems journals, we followed the recommendation of the Association for Information Systems and adopted the Senior Scholars’ Basket of Journals (AIS Basket of 8)[1] as our main source of articles as listed in Table 4. In selecting general management journals, we adopted a three-step

[1] Available at https://aisnet.org/general/custom.asp?page=SeniorScholarBasket

approach. First, we limited our initial search to the *Financial Times* list of 50 journals (FT50)[2]. Second, we used the Web of Science database to search for articles that include our search keywords in the time frame selected. Third, we selected nine journals (Table 4) that returned the largest number of articles containing our search keywords. The efficacy of this three-step approach, which is based on the authors' experience in conducting literature reviews, becomes clear when we discuss backward and forward searches in Steps 5 and 6. Based on the relevant citations included in articles found using this three-step approach, we included another journal in our Web of Science database search: *Academy of Management Annals*.

3.1.3 Step 3: Decide search engine and method

The Web of Science database includes all journals selected in our time frame. Thus, we used it as our main search engine. We also used Google Scholar, particularly in Steps 5 and 6 as we discuss later. To identify articles to be downloaded into our Zotero database, we proceeded as follows. First, we ran a search query using the Web of Science to return all journal articles (regardless of venue) that included our search keywords (Step 1 above). Second, we ran a search query using the Web of Science to return all articles published in the time frame in each of our selected journals (regardless of having these keywords). Finally, we combined the two queries for each journal to return all articles that included our keywords in that journal.

3.1.4 Steps 4: Create a to-keep list and download articles to the Zotero database

Step 3 generated 382 articles from the AIS Basket of 8, and 549 articles from the general management journals. We carefully read the abstract of each article and retained 67 articles from the AIS Basket of 8, and 66 articles from the general management journals. We added these articles to a to-keep list and later downloaded them in PDF format to a Zotero database. The backward and forward searches (Steps 5 and 6) uncovered 27 and 34 additional articles from information systems and general management journals, respectively. We added these articles to the to-keep list and later downloaded them to the Zotero database.

3.1.5 Step 5: Do backward citation

The first approach we used to overcome the two limitations associated with the time frame and publication venue was a backward citation search. That is, we made a list of all references in the 133 initially downloaded articles and recorded the frequency of each citation in this list. All articles that discussed technology implementation, cited at least three times, and received 100+ citations on Google Scholar by January 2020 were added to our to-keep list regardless of their publication time frame or venue. Naturally, some of the highly cited articles, specifically those that discussed theory or methodology, were referenced more than three times. Thus, we did not keep articles without a technology implementation component.

Table 4. Frequency of Articles in the Database based on the Publication Venue

Information Systems Journals (MIS)	#	Strategy & Management Journals (S&M)	#
European Journal of Information Systems	14	Academy of Management Journal	19
Information Systems Journal	7	Academy of Management Review	2
Information Systems Research	10	Administrative Science Quarterly	6
Journal of the Association for Information Systems	4	Journal of Management	2
Journal of Information Technology	9	Journal of Management Studies	7
Journal of Management Information Systems	5	Management Science	5
Journal of Strategic Information Systems	17	Organization Science	11
MIS Quarterly	28	Organization Studies	1
Other MIS Journals	8	Strategic Management Journal	17
		Academy of Management Annals	6
		Other Management Journals	4
Total	102	Total	80
Both venues of Journals			182

[2] Available at https://www.ft.com/content/3405a512-5cbb-11e1-8f1f-00144feabdc0

3.1.6 Step 6: Do forward citation search

The second approach we used to overcome the two limitations associated with the time frame and publication venue was a forward citation search. That is, we used Google Scholar for each article we downloaded to see who cited the article after it was published. We read the abstract of each citing article to determine its suitability for our research. We downloaded relevant articles to our Zotero database.

Finally, during the review and coding process, which is discussed in the next section, we uncovered articles not included in our Zotero database and added them to the database. Similarly, during the review and coding process, we identified articles that have no relevance to our research and removed them from the database. Consequently, our final database includes 182 articles published between 1983 and 2020 in and outside our two publication sources: AIS Basket of 8 and FT50. We provide a summary of this database in Table 4.

3.2 Review Process

In this section, we discuss the review process and focus on three aspects: general characteristics of reviewed articles, concept matrix, and coding of implementation enablers and inhibitors based on our TIF. We reviewed the articles in our database twice. In the first pass, we quickly read the articles and extracted general characteristics including technology, level of analysis, and research method. The 182 articles include one opinion article, three research notes, and two commentaries. The rest are research articles. Table 5 provides a summary based on the level of analysis encountered in these articles. Table 6 lists the research methodologies used by scholars to study technology implementation.

In the second pass of our literature review, we carefully read all articles and populated our concept matrix with 13 specific insights from each article. Table 7 presents these insights. In this table, we show how we code different aspects for two articles: Dale and Scheepers' (2019) research on enterprise architecture implementation and Kranz et al.'s (2016) research on business model change when organizations implement on-premise and cloud-computing software. Although most coding aspects are straightforward and not subject to different interpretations, two aspects—implemented systems and key challenges—are of particular importance and deserve elaboration. Implemented systems (row 4) in Table 7 represent the actual technologies being implemented in the organization studied. These technologies are further coded into the type of technology (row 5) under the idealized disruptive technology categories (Table 1). We closely followed the definitions of the idealized technology categories. We provide specific examples in Table 8.

Table 5. Level of Analysis

Level of analysis	Digital Technologies	Function IT	Network IT	Enterprise IT	Traditional (Non-IT)	Ambiguous & Other	Total
Individual	1	6	2	10	3	2	24
Project	1	5	1	10	2		19
Organization	11	12	4	26	14	12	79
Multi-level	7	9	3	5	7	7	38
Industry		4	1	3	12	2	22
Total	20	36	11	54	38	23	182

Table 6. Research Methodologies

Methodology	Digital Technologies	Function IT	Network IT	Enterprise IT	Traditional (Non-IT)	Ambiguous & Other	Total
Case study	17	21	7	32	13	10	100
Survey	2	4	1	11	2	3	23
Secondary data		2	2	3	13	3	23
Conceptual		3		2	8		13
Literature review	1	3	1	3		2	10
Mathematical model		1		1	2	2	6
Meta-analysis		1		1		2	4
Experiment		1				1	2
Q-sort				1			1
Total	20	36	11	54	38	23	182

Table 7. Sample Coding for Two of the Reviewed Articles

#	Coding Item	(Dale and Scheepers, 2019)	(Kranz et al., 2016)
1	Organization / firm	Two international banks	Six incumbent vendors of ERP software
2	Research method	Two in-depth case studies	Multiple case studies; Secondary data
3	Level of analysis	Organization	Organization
4	Implemented systems	Enterprise Architecture (EAI)	On-premises and cloud-computing software
5	Type of technology	Enterprise IT	Mixed: Function IT; Digital technology
6	Tech. characteristics	Modular systems; well defined a priori.	Software as a Service has distinctive characteristics of disruptive innovations
7	Implementation mechanism	Two phases: technology product selection and implementation planning and execution	Combines business model experimentation with a structured and systematic approach that allows translating creative ideas into specific activities
8	Key challenge(s)	Leadership	Organizational structure
9	Theoretical lens	Wenger's (1998) Communities of practice theory (as cited in Dale and Scheepers, 2019)	N/A
10	Independent variables	Different leadership styles	Absorptive capacity; organizational ambidexterity
11	Dependent variables	Implementation mechanisms	Business model change
12	Outcome	A key finding of this research is that an EAI may fail if architects do not build effective connections with business and technology stakeholders	Several challenges for incumbent firms, about adapting to new business models
13	Impact	Bank 1 outcome and impact differ from those of Bank 2. These differences include …	Firms with structurally separated units and slack resources face a higher likelihood of failures

Table 8. Examples of Implemented Disruptive Technologies

Category	Definition	Group	Examples
Digital	Technologies that employ digital objects over the Internet to provide distributed or remote organizational resources.	Blockchain	Blockchain-FinTech (Du et al., 2019)
		Cloud	Digital videogame platform (Ozalp et al., 2018)
		Social	Jive & Yammer: Social Media Sites (Neeley & Leonardi, 2018)
		Mobile	New technology for mobile platforms (Hardy & Thomas, 2014)
		IoT	Smart metering technology (Wunderlich et al., 2019)
Function IT	IT that assists with the execution of discrete tasks	Individual	3D computer-aided design & drafting (Klein & Sorra, 1996)
		Group	Decision support system (Jiang et al., 2000)
Network IT	IT that facilitates interactions without specifying their parameters	Collaboration	Collaboration/file-sharing tools (Polites & Karahanna, 2012)
		Trading	Electronic trading (Heracleous & Barrett, 2001)
		SOA	Service-oriented architecture (Li & Madnick, 2015)
Enterprise IT	IT that specifies business processes	ERP	Enterprise resource planning (Alvarez, 2008)
		CRM	Customer resource management (Kim & Mukhopadhyay, 2011)
		PLM	Product lifecycle management (Bala & Venkatesh, 2016)
		GIS	e-Government (Azad & Faraj, 2011; Wastell, 2006)
		HMS	Health management system (Schlichter & Rose, 2013)
Traditional (Non-IT)	Technologies that convert inputs into outputs to achieve commercial or industrial objectives. Typically, non-IT based.	Industrial	Biotechnology (Kapoor & Klueter, 2015)
		Medical	Medical imaging devices (Barley, 1986, 1990)
		Computer	Typewriters and personal word processors (Danneels, 2011)
		Robotics	Controlled machines (Avgerou, 2001; Roy & Sarkar, 2016)
		Renewable	Solar photovoltaic technology (Furr & Kapoor, 2018)

Key challenges (row 8) in Table 7 represent one of the leaf elements in the TIF shown in Figure 1. In examining the key challenges, enablers, and causes of successful and not-so-successful disruptive technology implementations in each article, we incorporated as many of the TIF elements as possible. That is, if the findings of the research pointed to three elements, for example, we coded the article as having three elements even if one or two were weaker. Our objective was to incorporate as many elements of TIF as possible and to see whether the scholars examined the interactions among these elements. Some articles provided a clear description of the issues faced by organizations implementing disruptive technology.

We identified 23 articles that are either ambiguous about the technology implemented or focus on strategic initiatives. For example, in one article, the authors use mobile technology but do not focus on its implementation; thus, we could not establish how mobile technology disrupted organizational routines and processes. A few articles include a vague reference to technology but focus on other strategic initiatives including strategic change, adaptive mechanisms, or implementation tactics. Because our objective is to examine disruptive technology implementation, we excluded these articles. Other articles were either brief or lacked a clear description of the challenges. In the end, we used only 139 of the 182 articles to code TIF elements. We excluded articles that were unclear about how disruptive technology was implemented, articles that used technology that complemented previously implemented technology (sustaining or nondisruptive), conceptual articles that did not empirically examine specific aspects of technology implementation, and literature reviews. Table 9 provides examples illustrating how each TIF element was coded based on details provided in Table 2.

Table 9. Examples of Coding TIF Leaf Elements

Category	TIF Element	Example
Structural	Organizational Structure	“Firms with structurally separated units and slack resources face a higher likelihood of failures, indicating that creating favorable conditions for organizational experimentation may decrease discipline.” (Kranz et al., 2016, p. 504)
	Control Mechanisms	“Loose budgetary control affects the ultimate implementation results. Organizations that use cost as the primary determinant of success need to evaluate the extent to which they exert control over project budgets, particularly if they are prone to cancellation.” (Conboy, 2010, p. 283)
Strategic	Strategic Consensus	“Due to the long entrenchment of MediaNews’ culture within established print routines, it took MediaNews over 15 years to shift from a primarily print to primarily digital newspaper strategy for their publications (i.e., from the strategy’s earliest formulation to product launch).” (Utesheva et al., 2016, p. 349)
	Strategic Diffusion	“The paper suggests that informal network change within interdependent organizational groups is unlikely to occur until users converge on a shared appropriation of the new technology's features such that the affordances the technology enables are jointly realized”. (Leonardi, 2013, p. 749)
Interpersonal	Leadership & Decision-making	“Organizational leadership needs to pay attention to balanced and participative team designs and need to account early for organizational resistance to change.” (Bernroider, 2013, p. 254)
	Communication & Interaction	“The IT engineers and the court personnel spoke different languages and had major difficulties communicating with each other, while the developers were looking for codifiable processes; they often received elaborations full of legal jargon. Managers needed to control the multiplicity of interpretations allowed by the new system.” (Faik & Walsham, 2013, p. 362)
	Autonomous Behaviors	“When implementing new information systems, organizations often face resistance behavior from employees who avoid or underutilize the system. The study results show that work routines are an object of resistance during IS implementations. Interventions should focus on both the new technology and changing work routines.” (Laumer et al., 2016, p. 316)
External	Environmental or Ecosystem	“We argue that an “unowned” view of process that elevates chance, environmental uncertainty, and the unintended consequences of choice in accounting for strategic change is a more processual way of understanding the eventual demise of NorthCo Automotive.” (MacKay & Chia, 2013, p. 208)
	Other External	“Client firms expect consultants to transfer their implementation knowledge to their employees so that they can contribute to successful implementations and learn to maintain the systems independent of the consultants.” (Ko et al., 2005, p. 59)

4 Discussion of Findings

Our objective is to understand how incumbent organizations implement disruptive technologies successfully[3]. The analysis and coding of the 139 empirical articles in our database reveal insights that are helpful to both managers implementing disruptive technologies and scholars researching this topic. Individual studies often deal with one technology being implemented, and hence it is difficult to compare them and identify comprehensive conclusions (Garg & Agarwal, 2014; Gupta et al., 2018; Koh, et al., 2011; Leonard & Higson, 2014). In contrast, our findings allow for comparison across different technologies and various challenges to successful technology implementation.

We discuss four facets of the findings. First, we briefly discuss some statistical aspects of the studies. Second, we discuss how scholars examined various TIF elements. Third, we discuss how implementing digital technologies is different from implementing other disruptive technologies. Finally, we argue that implementation success in organizations requires success on two fronts: technical installation quality and the achievement of the organization's strategic objectives from the implementation.

4.1 Statistics

Table 10 presents statistics for the reviewed articles. First, only six of the 139 articles provide technical details about the technology or system being implemented. In other words, scholars are often focused on the social aspects of technology, bypassing the technical aspects. Second, the most common research methodology used to examine technology implementation in organizations is the case study method (93 out of 139 articles). The following most common methods are surveys and secondary data methods, which appear in 20 articles each, followed by mathematical models and experiments (6 in total). Third, less than 30% (39/139) of the articles provide clear evidence regarding the success or failure of the implementation effort. Such evidence of success is sometimes explicit in the articles' Discussion sections or in the survey' results, but in most papers, the evidence is embedded in the text, or the examples cited from the interviews[4]. We provide details about implementation success in Section 4.4.

Table 11 lists all the disruptive technologies reported in the literature we examined. Some organizations implemented more than one technology, and many organizations implemented similar technologies. In total, we found 163 implemented technologies, 75 of which are unique. The lack of technical details (Table 10) prohibits more specific distinctions among these technologies. For example, researchers described 26 ERP systems, but we do not know if these systems are identical, include the same modules, or have similar characteristics. This paucity of technical details about the implemented technologies also makes linking the challenges to the technical characteristics more difficult.

Technology implementation is a multilevel phenomenon, and the challenges often interact at several levels. Many scholars have studied technology implementation using a single level of analysis, as shown in Figure 2. In every technological category, we see a preference for the organizational level of analysis (ranging from 34% to 58%). In contrast, the multilevel of analysis is less frequent. The researchers' choice may be driven by how organizations view their challenges.

Table 10. Statistical Aspects of the Reviewed Literature

Technology	**Number of articles**	**Technical details**	**Research method**				**Evidence of successful implementation**
			Survey	Case study	Secondary data	Other	
Traditional	32		2	15	13	2	6
Function-IT	29		4	21	2	2	5
Network-IT	10		1	7	2		2
Enterprise-IT	49	4	11	33	3		20
Digital	19	2	2	17			6
Total	139	6	20	93	20	6	39

[3] Note that our literature review provides us with insights on both disruptive and non-disruptive technologies. At times, we present insights that are not specific only to disruptive technologies but that also apply to non-disruptive technologies.

[4] We thank the editor-in-chief of the *Communications of the Association for Information Systems*, Professor Fred Niederman, for suggesting this clarification.

Since most of the literature employs case study methodology, the focus of the scholars may reflect the data which is based on how these organizations identify and react to the challenges. Furthermore, most of the literature identified one or two challenges as discussed in the following section—pointing to the absence of a multi-level view of the challenges.

Scholars who examined digital technologies used a multilevel analysis in 32% of the articles. In comparison, those who focused on other technological categories used a multilevel analysis in 20% or less in their research. Studying implementation at the industry level of analysis is absent from the digital technology articles but present at every other technological category. The industry level of analysis peaks at the traditional (non-IT) research as many scholars employ secondary data analysis techniques.

We propose that:

P1. Organizations that address the TIF challenges at multiple levels (individual, project, organization, industry) have a higher chance of achieving successful disruptive technology implementation.

Table 11. Disruptive Technologies as Reported in the Examined Literature

Category	**Publication venue**			**Names of technologies reported in the literature**	**Number of technologies**	
	MIS	S&M	All		Total	Unique
Traditional	4	28	32	Automation technology (6); Medical Imaging Devices (3); Computer Memory products (3); Printing technology; Computer Controlled Machines (2); Cardiac Surgery technology (2); Typewriters; Personal Word Processors; Desktop Computers; Electricity-generation Products; Mainframe; Mini-computers; Flat Panel Screens; Air Conditioning technology; Solar Photovoltaic technology; Biotechnology; Robots	26	16
Function IT	21	8	29	General IT (14); Application software (4); Decision Support system: DSS (4); Computer-Aided Software Engineering: CASE (4); Transaction Processing system: TPS; Computer Technologies; Reporting software; Hospital IS; Collaboration Technology; Presentation software; Accounting system; Windows Operating system; Financial IS; Lotus Notes	37	15
Network IT	7	3	10	Internet & Intranet (3); Collaborative Technology (2); Electronic Trading; Mobile IS; Service Oriented Architecture: SOA; IT Networking Infrastructure; Self-serve Technology; Telehealth system	12	9
Enterprise IT	43	6	49	Enterprise Resource Planning: ERP (26); Enterprise system (3); IT Healthcare system (3); Hospital Information Support system (2); Customer Relationship Management: CRM (2); Inter-organizational IS: IOIS (2); Supply Chain Management: SCM; SalesForce; eCare Health Network; Paper Management system; Mill Execution system; Electronic Medical Record system; Land registration & Mapping; Product lifecycle management system; Patient Care IS; e-Government system; Production & Inventory Control IS; Global Enterprise-wide system; Product Configuration system; Two-way Interaction system between police and prosecutors; E-procurement; Banking System; Warehousing & Transporting operation system; Software Process Improvement system; Enterprise Project Management; Remote Patient Monitoring system; eGovernment: Geographical Information System; Electronic Data Interchange: EDI	68	36
Digital	8	11	19	Digital Platform (6); Blockchain: FinTech; Digital Video Recorder: DVR; Software as a Service: SaaS; e-books & apps; Web-based ERP; Cloud-computing software; Digital Videogame Platform; Online Digital Publishing; B2C Ecommerce Platform; IoT: Smart metering technology; Mobile Platform; Infotainment System; Time planning & resource analytics digital system; Jive: Social Media Site	20	15
Total	83	56	139		163	75

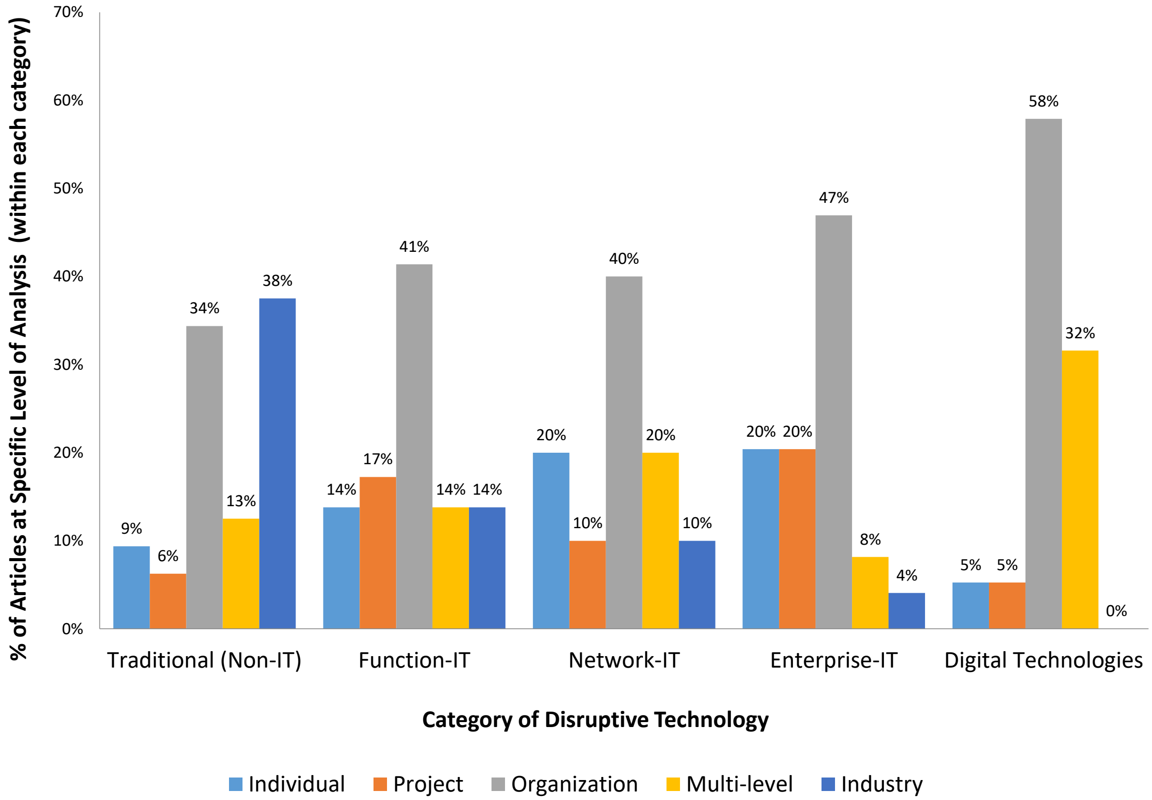

Figure 2. Level of Analysis

4.2 Challenges to Implementing Disruptive Technologies

In this section, we first summarize the major challenges in each technological category. Then, we show how most of the literature uses a single challenge when discussing technology implementation. Finally, we provide examples from the literature for each TIF element.

Our TIF informs us that the challenges to implementing disruptive technology are both internal and external (Figure 1). The internal challenges are structural, strategic, and interpersonal, classified as organizational structure, control mechanisms, strategic consensus, strategic diffusion, leadership and decision making, communication and interaction, and autonomous behaviors. The external challenges are related to environmental/ecosystem or other external elements. Table 12 provides representative samples of TIF leaf elements. Table A1 in Appendix A lists the reviewed articles coded under each TIF element.

We argue that implementing different categories of disruptive technologies should lead to different distribution patterns of the challenges. Our analysis provides evidence to support this hypothesis. Figure 3 shows the distribution of challenges faced by organizations based on each category of disruptive technology. Although the largest percentage of challenges in every technological category is interpersonal, every category of disruptive technology comes with a distinct pattern of challenges. In other words, there appears to be a relationship between the technological category and the distribution of challenges. This relationship can be broadly explained by understanding the distinct nature of each technology (Table 1).

Traditional (Non-IT) technologies are physical and material objects or tools that can convert inputs into outputs (e.g., biotechnology, microchips, MRI machines). These technologies require external expertise to implement technically, change the production processes and introduce new players. Consequently, the combined structural, strategic, and external challenges represent over 50% of the challenges. In contrast, function-IT technologies assist with the execution of discrete tasks and are often introduced as independent third-party software packages (e.g., spreadsheets, computer-aided design, statistical software) that can be easily installed on individual computers or on the network. Thus, there are few external challenges, and the structural and strategic challenges come second to the interpersonal challenges.

Both network-IT (e.g., Email, Intranet) and enterprise-IT (e.g., ERP, CRM) implementation are dominated by the interpersonal challenges. Because network-IT technologies facilitate interactions, we see that structural challenges come second followed by strategic and external challenges. In contrast, enterprise-IT technologies disrupt the existing business processes causing strategic challenges to come next followed by the structural challenges. Finally, digital technologies show a different pattern that resembles the pattern of challenges seen with function-IT technologies. Digital technologies (e.g., digital platforms, software as a service) are tools and systems that provide distributed or remote organizational resources helpful in the execution of discrete tasks—likely at a more distributed and global scale when compared with the tasks achieved with function-IT technologies. Nevertheless, due to its distributed nature, the external challenges are three-fold when compared with function-IT external challenges.

Therefore, we propose that:

P2. Organizations that recognize the link between the nature of the disruptive technology and the pattern of the implementation challenges have a higher chance of identifying and eliminating these challenges.

Table 12. Representative Samples of TIF Leaf Elements

Category	Leaf element	Sample literature
Structural	Organizational Structure	"Contradictions between the initial social structure and the structure enacted in the use of an IOIS can be a cause of non-adoption." (Rodón & Sesé, 2010, p. 637) "A series of subtle but nonetheless significant changes were enacted over time as organizational actors appropriated the new technology into their work practices, and then experimented with local innovations, responded to unanticipated breakdowns and contingencies, initiated opportunistic shifts in structure and coordination mechanisms, and improvised various procedural, cognitive, and normative variations to accommodate their evolving use of the technology." (Orlikowski, 1996, p. 63)
	Control Mechanisms	"Consistent with the idea that organizations should provide employees freedom to identify and pursue opportunities, the implementation of TimeEdit did not originate within formal structures. This arrangement made IT staff prone to pick up problems and scan the market for solutions. TimeEdit was no exception." (Arvidsson & Mønsted, 2018, p. 374) "Organizations should establish more control over this teambuilding process which affects the establishment of resources and the effectiveness of the technology implementation." (Bernroider, 2013, p. 254)
Strategic	Strategic Consensus	"Blockchain implementation requires a culture that supports collaboration with startups. Because blockchain lacks prior installations, its implementation can impose unexpected constraints upon an organization and thus requires a phase for constraint mitigation". (Du et al., 2019, p. 62) "Based on experience, managers develop mental representations of markets, products, and technologies that are often imperfect. Over time, these representations become taken-for-granted and expressed in a dominant design". (Henfridsson et al., 2014, p. 28)
	Strategic Diffusion	"IT implementation is problematic, and this is at least partly because of the underpinning goals and visions of healthcare policy. If this misalignment is not addressed then producing technologically superior systems, or better IT implementation strategies, is unlikely to result in widespread and substantial changes to the way healthcare is delivered and experienced." (Klecun, 2016, p. 64) "The study shows that, to implement successfully an IT-supported sustainability initiative, a thorough understanding of organizational routines and standards is required to enroll the affected stakeholders." (Bengtsson & Ågerfalk, 2011, p. 96)

Table 12. Representative Samples of TIF Leaf Elements (Continued)

Category	Leaf element	Sample literature
Interpersonal	Leadership & Decision-Making	Leadership plays key roles in overcoming several of the implementation challenges during the planning, developing and operating phases of the e-Government system. (Chan et al., 2011, see Tables 4, 5, and 6) “Main implementation barriers include a lack of formal power and influence over the organization targeted for change, weak support from top management, and organizational memories of prior failures.” (Ngwenyama & Nielsen, 2014, p. 205) “Emergent decision processes produced easier access to information, quicker response to customer information requests, and faster inventory planning. Further, two main factors drive flexible decision making: a lack of managerial power and a lack of financial resources.” (Power & Gruner, 2017, p. 174)
	Communication & Interaction	“The implementation experienced escalating commitment as unexpected gaps constantly emerged. Many of these were also hidden from managers, who thus failed to observe and respond to the actual problematic status of the process.” (Lyytinen et al., 2009, p. 299) “Business and IT staff had to work closely together; for example, it required that all product designers standardize the creation of new product attributes in the ERP system.” (Yeow et al., 2018, p. 52)
	Autonomous Behaviors	User resistance falls into four key categories: individual, system, organizational, and process issues. These are generalized from twelve determinants of this autonomous behavior. (Klaus & Blanton, 2010, see Table 2) “Although, technically the implementation was successful, strategically, however, the implementation failed, as it did not produce intended organizational change; instead of creatively using the new system to enable the new strategic intent, the system was creatively implemented to reproduce existing practices. In essence, the organization appears stubbornly and strategically blind.” (Arvidsson et al., 2014, p. 46)
External	Environmental or Ecosystem	“Technology changed the nature of the interactions with the clients leading to resistance.” (Schultze & Orlikowski, 2004, p. 87) “Continual strategic adjustments made by the disruptor to address emergent coopetitive tensions have consequences for its technology, capabilities, and, eventually, its place in an ecosystem that itself is evolving. In TiVo’s case, over time, such strategic adjustments resulted in significant changes to its DVR technology platform as well as its relational positioning vis-à-vis industry incumbents.” (Ansari et al., 2016, p. 1843)
	Other External	“The two Universities have implemented the same system in different contexts. University 1 started implementing the system earlier than University 2, when there was less commercial pressure on the sector. University 1 also implemented the system within the context of relative structural stability, whereas University 2 underwent considerable structural change in parallel with the implementation. The phases at each university showed different patterns of strategising by the top management team. These affected the extensiveness and fluidity of system use.” (Leonard & Higson, 2014, p. 73) Technology characteristics affected both implementation outcomes and users' learning activities. [However,] technology and learning activities independently affected implementation outcomes, with no evidence of mediation or moderation.” (Aiman-Smith & Green, 2002, p. 421) “The very non-work-related content that attracts users to social media and shapes passable trust can become a source of tension, thwarting a firm’s ability to encapsulate knowledge in the form of routines and to use it to enact its strategy.” (Neeley & Leonardi, 2018, p. 922)

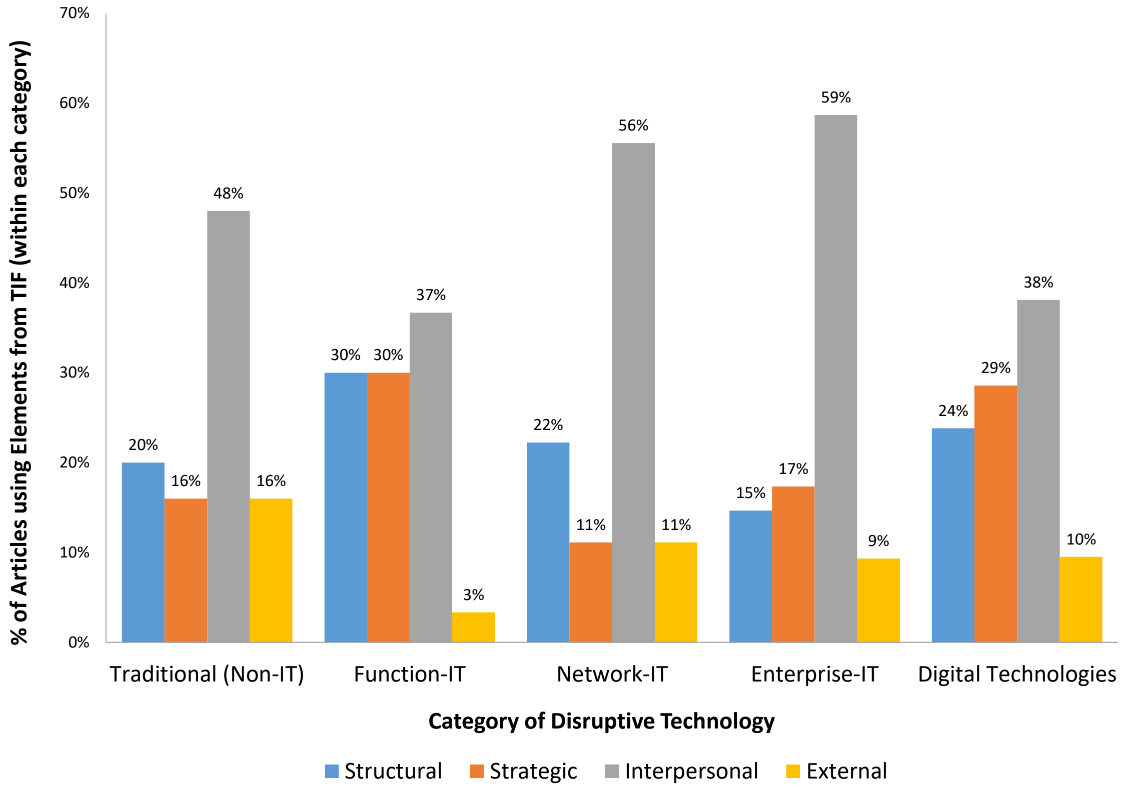

Figure 3. Distribution of Challenges Faced by Organizations

More than 20 years ago, Gottschalk (1999, p. 116) observed that research on technology implementation "lacks the gestalt perspective." This lack of a holistic treatment of the challenges associated with implementing disruptive technologies persists today. In other words, scholars examine disruptive technology implementation from a single perspective or a couple of perspectives, that is, using a single element or a couple of leaf elements from the TIF illustrated in Figure 1 and detailed in Table 2. Figure 4 shows the TIF leaf elements used in the examined literature. Most articles used a single element when discussing the challenges associated with technology implementation, a small percentage (regardless of the technological category) used two elements, and an even smaller percentage used more than two. None of the articles used more than four of the possible nine leaf elements of the TIF. Some articles did not specify any challenges and hence were coded as having zero TIF leaf elements. Thus, most previous research has focused on a single challenge, and in the process, has not paid sufficient attention to the interaction among challenges, which represents a threat to successful technology implementation. In the following paragraphs, we focus on the various challenges and provide examples of each TIF element.

The structural category consists of challenges associated with an organization's structure and control mechanisms. The organizational structure is concerned with the alignment between the technology being implemented and the business model and structure of the organization, or the structure of individual business units. In an in-depth case study, Dhillon et al. (2011) assert that implementing an ERP system coincided with significant restructuring of power relations in a European real estate asset management firm. Similarly, Leonard and Higson (2014) contrast the structural changes and their impact on the success of implementing an ERP system in two universities

Rodón and Sesé (2010) study the implementation of inter-organizational information systems (IOISs) in the port of Barcelona. They show that the contradictions between the initial social structure and the structure that results when using an IOIS can cause non-adoption. Orlikowski (1996) and Barley (1986, 1990) show that implementing new technologies shifts the structure and coordination mechanisms in a software company headquartered in the Midwest and radiology departments located in two hospitals in Massachusetts, respectively.

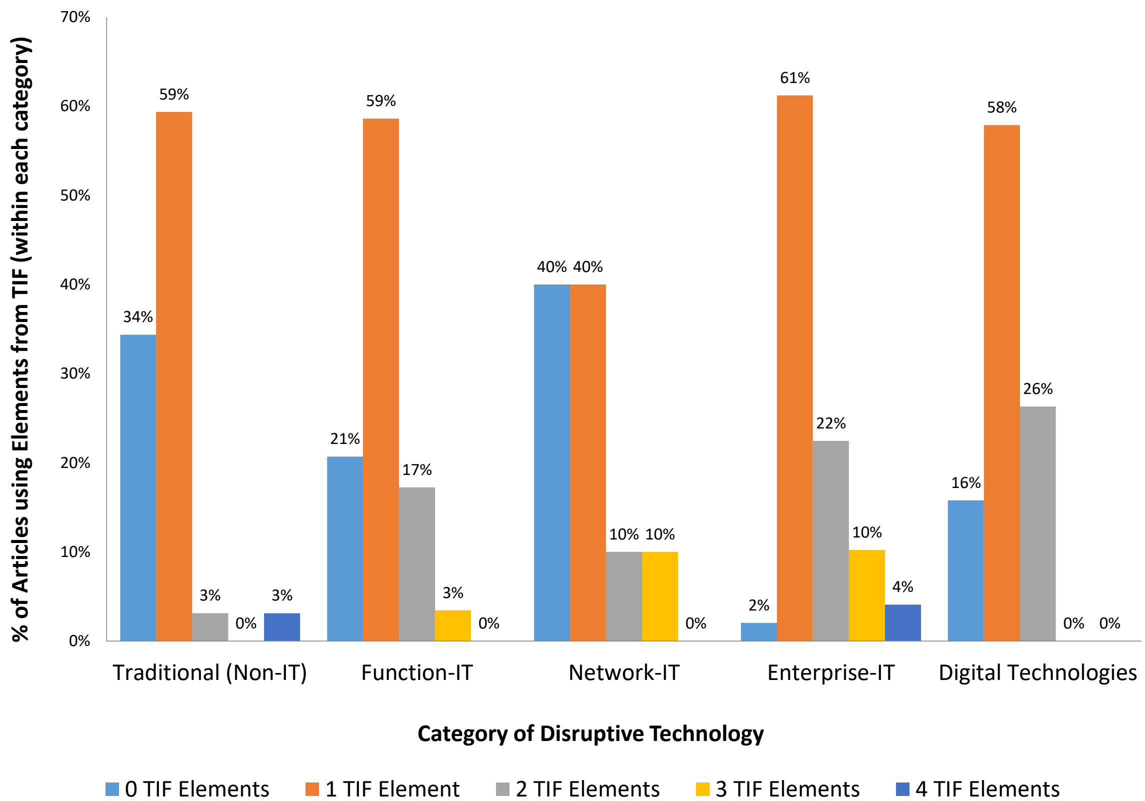

Figure 4. Usage of TIF Leaf Elements (out of Possible 9) in the Examined Literature

The control mechanisms ensure that the implementation objectives are met through planning, monitoring performance, and making corrections if the objectives are not met. Control mechanisms are either formal or informal. Formal mechanisms (e.g., accounting-based control) specify either the desired outcome or behavior and informal mechanisms rely on either clan-type control, where common values and beliefs are shared, or self-type control, where self-imposed norms prevail (Choudhury & Sabherwal, 2003). In a case study examining the implementation of an electronic medical record technology in Sentara healthcare, Abraham and Junglas (2011) show how the organization transforms its control (coordination, culture, and learning) to ensure successful implementation. Lack of formal control during technology implementation may have a positive impact. In a Norwegian hospital, IT staff enjoyed the freedom to identify and pursue opportunities while implementing a time-planning and resource analytics system. Consequently, the IT staff managed to turn a failed technology implementation into success over time (Arvidsson & Mønsted, 2018).

The strategic category includes two leaf elements: strategic consensus and strategic diffusion. Strategic consensus refers to the shared understanding and commitment to a strategic directive among individuals or groups (Noble, 1999). Strategic consensus is strongly associated with an organization’s identity and culture. For example, Utesheva et al. (2016) find that the shifts in the evolutionary trajectory of an organization due to digital disruption can be traced to the rate and nature of identity metamorphoses among its key actors. In this case, an established major newspaper and media company took 15 years to shift from a primarily print to a primarily digital newspaper strategy for its publications despite the successful technical implementation of the company’s online digital publishing system.

Strategic diffusion refers to the need to diffuse the technology implementation strategy and plans from their originators (e.g., consultants, top and middle managers) to the rest of the organization to eliminate autonomous behaviors that may hinder implementation efforts. Sponsors, adopters, firm-level factors, and the nature of the technology being implemented may all contribute to a lack of diffusion (Cooper & Zmud, 1990; Eggers & Park, 2018; Noble, 1999). Nokia’s loss of the smartphone battle is an example. Vuori and Huy (2015) describe how Nokia’s top managers failed to diffuse the objectives of their technology implementation strategy. At the same time, Nokia's middle managers failed to upwardly diffuse the challenges associated with their efforts to innovate. These diffusion failures contributed to the demise of what used to be one of the most successful telecommunication companies.

The last category of internal challenges is interpersonal, which focuses on the interactions and behaviors that inhibit successful technology implementation and the roles that leadership and communications play in combating this set of challenges. The interpersonal category includes leadership and decision making, communication and interaction, and autonomous behaviors. This category is by far the most documented in the literature. Leadership plays an important role in overcoming the challenges associated with implementing disruptive technologies. Leadership, at various levels, creates an organizational climate in which implementation happens. Nevertheless, leaders are required "to understand the deeper values and beliefs of these stakeholders that are enshrined in the groups' discursive structures because these are what persist over time and guide actors' interpretations and actions" (Heracleous & Barrett, 2001, p. 774).

A recent study by Dale and Scheepers (2019) about implementing enterprise architecture systems in two comparable banks shows that leadership affected how two comparable systems were implemented differently. At the first bank, leaders lacked effective connections with business and technology stakeholders and hence failed to implement their planned project. At the second bank, leaders built the support and commitment needed for the technology products they selected, and hence the enterprise architecture system's initiative was successful.

The communication and interaction TIF element represents vertical and lateral integration, obtaining broad-based inputs and participation, and enacting defensive routines, and working around them. It is also concerned with developing and cultivating a culture that embraces collaboration and open communication, thus facilitating the implementation of new and complex technologies. The seminal article by Edmondson et al. (2001) about implementing minimally invasive cardiac surgery technology in 16 hospitals shows how communication and interaction affect successful implementation. Specifically, the authors show that successful implementers used enrollment to motivate the team, designed preparatory practice sessions and early trials to create psychological safety and encourage new behaviors, and promoted shared meaning and process improvement through reflective practices

Autonomous behaviors are manifested as either passive compliance or upward intervention, which includes deliberately creating barriers to implementation. These behaviors are often associated with resistance to technology implementation rooted in everyday work that cannot be addressed by simply altering employee behavior. Arvidsson et al. (2014) show how the employees of a paper mill used autonomous behavior to cause the successful technical implementation of a production management system to fail strategically. They refused to use it as intended and made it work to reproduce existing practices.

The external category of challenges represents around 10% of the reported challenges and includes two leaf elements: environmental or ecosystem, and external challenges. Environmental turbulence and uncertainty often complicate the implementation of disruptive technologies (Laumer et al., 2016; Martinez-Simarro et al., 2015). Similarly, ecosystem challenges, cohesion, and diversity (Snider et al., 2009), and the availability of external resources affect implementation efforts (Canato et al., 2013; Stieglitz et al., 2016). Furthermore, the complexity of implementing disruptive technologies often increases when an organization is pressured to implement them in less than optimum time due to competition or other external interventions (Brown, 1998; Guth & MacMillan, 1986).

A few articles report other external challenges. These include dependence on consultants (Berente & Yoo, 2012), emergent change in practice (Kelly & Amburgey, 1991), technology vendor-side challenges (Chan et al., 2011; Chanias et al., 2019), and technology characteristics (Polites & Karahanna, 2012). All these complicate the implementation of disruptive technologies. Digital technologies, in contrast, have unique characteristics that may reduce these challenges, as discussed in the next section.

4.3 Digital Technologies

Are the challenges faced by organizations implementing digital technologies unique or like the challenges encountered with prior disruptive technologies? This is our second research question. Evidence from our literature review provides mixed answers. On the one hand, many of the digital technologies face the same challenges found with other disruptive technologies as discussed in the previous section (Figure 3). On the other hand, digital technologies have unique characteristics that clearly set them apart from prior technologies. Digital technologies are more flexible to implement, operate independently on various platforms, can be introduced gradually in small steps, and can be combined from different sources. The skills required to build and operate digital technologies evolve during the implementation process and fit well with the knowledge needed to operate other information technologies. Furthermore, digital technologies open the door for new forms of collaboration not possible with traditional technologies. These forms include both internal and external collaborations, eliminating many barriers that obstruct traditional technology implementation initiatives. Some of the unique characteristics associated with digital technologies sharply contrast those of other disruptive technologies. In general, implementing many kinds of disruptive technologies requires major investments and retooling before actual use. However, this is often not the case with digital technologies. Consequently, organizations can adjust their implementation plans and business models quickly in response to market and competitive demands when implementing digital technologies. We provide some examples.

The flexibility associated with digital technologies often requires a careful balancing of priorities. For example, TiVo navigated coopetitive tensions by continually adjusting its strategy, digital platform, and relational positioning in the evolving U.S. television industry ecosystem. Over time, such strategic adjustments resulted in significant changes to TiVo's DVR technology platform as well as the company's relational positioning vis-à-vis industry incumbents (Ansari et al., 2016). However, this flexibility may also have negative consequences, especially when a rapid response to disruption leads other organizations in the same ecosystem to fall behind. Ozalp et al. (2018) showed that incumbents introducing next-generation digital technology with advanced capabilities increased the challenges of developing complements for their digital technology. Thus, the flexibility of implementing advanced capability leads to steepening complementors' learning curves and disrupting the complementors that technology owners need to thrive in the next-generation competition.

Collaboration is another important aspect that sets the implementation of digital technologies apart from other disruptive technologies. Many small companies face significant challenges in their attempts to implement traditional ERP systems. Some of these challenges simply disappear with cloud computing. Consequently, small companies can take advantage of cloud computing by implementing web-based ERP II systems that provide full collaboration in the supply chain field (Koh et al., 2011). Utesheva et al. (2016) give a vivid example of internal collaboration achieved through digital technologies. At an established major newspaper and media company, analysts, designers, developers, testers, and user experience architects negotiated the technology selection, nonfunctional requirements, and major design decisions. In return, they received continual feedback from journalists, editors, and readers based on their ongoing engagement with the digital product, leading to dynamic adjustments to the implementation process (Utesheva et al., 2016).

In sum, digital technologies face challenges like other disruptive technologies, but their unique characteristics clearly set them apart from prior technologies, leading to innovation.

Therefore, we propose:

P3. Organizations implementing disruptive digital technologies improve their implementation success by capitalizing on the four unique characteristics of digital technologies: editability, modifiability, interactivity, and distributedness.

4.4 Implementation Success

The literature informs us that some technology implementation efforts are successful, and others are not. Furthermore, some technologies are used at various capacities after implementation, and others are abandoned. Finally, some technology implementation efforts take a short time and others continue for years. Consequently, it is important to derive a tool that assesses technology implementation success. This tool should also provide guidance on how to proceed when an organization needs to alter the implementation direction or decide whether to continue with an implementation effort or abandon it.

Disruptive technology implementation has technical and social aspects as acknowledged by the majority of scholars (e.g., Ngwenyama & Nielsen, 2014). Surprisingly, the social aspects have received the bulk of scholars' attention. In fact, some scholars consider technology implementation failures to be more related to social rather than technical factors (e.g., Markus & Benjamin, 1996). Indeed, the social factors may affect whether and how organizations achieve the desired technical quality. Notwithstanding this important position, the literature also provides clear evidence of the technical challenges' impact on such failures. Recent studies have reinforced this observation. For instance, Du et al. (2019, p. 52) state that "existing IT implementation studies tend to overemphasize the social aspects and treat the technical specifics as irrelevant.” This is also the case for traditional (non-IT) and digital technologies as we observe from this literature review.

Consequently, disruptive technology implementation, as a major strategic effort for most organizations, has two dimensions of success: technical and strategic. First, the technology must be installed successfully from a technical perspective (technical installation quality). Second, the technology must be utilized in accordance with the strategic objectives of the implementation (strategic implementation quality). Accordingly, we define *technical installation quality* as the fit between the designed functionality of a technology and its actual performance when this functionality is invoked by an expert or a well-trained user. We define *strategic implementation quality* as the fit between the designed functionality of a technology and its actual use within the organization to achieve the strategic objectives or needs that initiated the process of this disruptive technology implementation. Figure 5 shows the relationship between the successful implementation of disruptive technology and the two dimensions of this effort.

For example, let us assume that an organization purchases an accounting system (function-IT) to perform accounting and tax calculations. The organization tasks the IT department with the technical installation. Let us also assume that the IT department installs some modules of the system but fails to install some other modules due to a lack of expertise, infrastructure incompatibility, or technical issues that cannot be resolved without additional costs or use of external consultants. In this case, we consider the technical installation quality to be low. In contrast, when the IT department installs and tests all the modules of the system successfully in accordance with specifications before handing the system over to the users, then we consider the technical installation quality to be high. For this organization to be at a high level of strategic implementation quality, the users of the accounting system must utilize all applicable modules effectively to achieve the desired strategic objectives. When users ignore some of the system’s modules and continue to use older inefficient processes to achieve the objectives of the firm, then the organization is said to have a low level of strategic implementation quality. In other words, strategic implementation quality represents the fidelity between the affordances of the disruptive technology and its utilization.

Therefore, we propose that:

> *P4. Organizations that pay close attention to technical installation quality and strategic implementation quality have a higher chance of achieving successful disruptive technology implementation.*

Table 10 indicates that 39 articles provide clear evidence of successful disruptive technology implementation. Of these 39 articles, only 33 provide sufficient information to judge both dimensions of success: technical installation quality and strategic implementation quality. One article provides examples of the low-low dimensions of implementation in one organization and the high-high in another (Dale & Scheepers, 2019). Table 13 shows the distribution of articles in each quadrant of the success matrix. Table B1 in Appendix B lists the 33 articles based on their description of the two dimensions of success. Interestingly, only one of these articles was published in a management journal, the *Journal of Management Studies* (Brown, 1998). The rest of the articles were published in the MIS set of journals (Table 4). Examining Table 10, Table 11, and Table 13 leads to two observations.

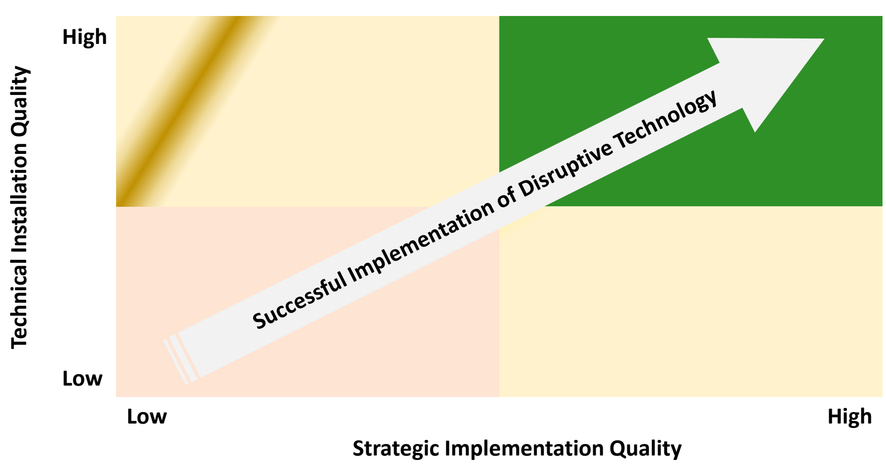

Figure 5. Disruptive Technology Implementation Success

Table 13. Distribution of Articles in Each Quadrant of the Success Matrix

Quadrant	**1**	**2**	**3**	**4**
Technical installation quality	**Low**	**Low**	**High**	**High**
Strategic implementation quality	**Low**	**High**	**Low**	**High**
Traditional (Non-IT) technologies				
Function IT		1	3	1
Network IT			1	1
Enterprise IT	5		9	6
Digital technologies	1	1	2	3
Total number of articles	6	2	15	11

First, traditional (non-IT) technologies are not represented in Table 13. That is, none of the articles in our database that discussed traditional technologies provided sufficient details to judge both dimensions of success simultaneously. The discussions in these articles are focused on the strategic aspects of the implementation and the challenges encountered during the process. The absence of the technical installation quality dimension may be attributed to the nature of the technology being implemented (Tables 8 and 11). Many of the traditional technologies are products developed by specialized firms then installed by the supplier in the implementing organization with little or no interaction from that organization during the installation. For example, Barley (1986, 1990) described the implementation of CT scanners in two hospitals in Massachusetts. Barley's focus was centered on the actions and interactions of radiologists and technologists performing x-ray and fluoroscopic procedures in the two hospitals before and after the installation of these new machines. Consequently, Barley did not describe the technical installation of these scanners—he simply stated that "once the scanners went on-line in late September," he shifted his observations "from the x-ray areas to the two newly created CT areas" (Barley, 1986, p. 85).

Second, there is a paucity of research focusing on quadrant 1 (low-low). Among the many possible reasons for this paucity, two reasons may be prominent: selection bias and organizational reluctance to allow scholars to study struggling or difficult implementation projects. For instance, Abraham & Junglas (2011, p. 179) state that their site "was purposefully chosen as the successful organization worthy of study because its characteristics met the following sampling criteria: … (2) embarking on IS implementation, yet demonstrating some very early successes which enabled assessing the occurrence of change and the managerial practices in the progression of the implementation." Decision-makers may be reluctant to allow access to scholars when their implementation efforts are not progressing as planned unless the scholars are hired as consultants to assist the organization. But even in this case, decision-makers may not consent to using the information gathered in the process for academic purposes. Another cause for such reluctance may be related to the difficult and charged environment surrounding failed implementation efforts. Some of the people involved may lose their jobs, be assigned to different tasks, or simply get frustrated with unsuccessful efforts due to technical or TIF related challenges.

4.4.1 The four quadrants of implementation success

Quadrant 1: the low-low quadrant

In the low-low quadrant of Table 13, we see cases where the implementation struggled technically, and the organization could not use the technology to achieve the intended objectives. Technical problems typically cause an implementation project to collapse, particularly in large and complex projects (e.g., ERP implementation: Schlichter & Rose, 2013). Similarly, the misalignments of input, control, data, process, output, and schedule are some of the major problems in the project phase (Wei et al., 2005). These problems can be compounded with a lack of expertise, shortage of resources, and trust collapse in the organization. Besides, conflicts and technical problems can lead to systems that appear to be relatively less stable, and hence stakeholders may find it easy to resist or even abandon the new technology (Bernroider, 2013).

Quadrant 2: the low-high quadrant

In rare cases, the installed technologies did not meet the planned functionalities or capabilities in technical or clinical ways; however, the organizations were able to achieve their strategic objectives by finding creative solutions to the technical challenges. This is the case in the low-high quadrant of Table 13. For example, when a time planning and resource analytics system failed during its installation in a Norwegian hospital, members of the information systems team found creative solutions to resolve the technical issues and restored the system to its full potential (Arvidsson & Mønsted, 2018). In another organization, to overcome the technical challenges, managers used flexible IOS technology adoption and implementation strategies to promote organizational performance (Power & Gruner, 2017).

Quadrant 3: the high-low quadrant

Most of the literature, however, discusses cases that fall in the high-low quadrant of Table 13, where the technologies or systems installed achieved reasonable technical and clinical success in a relatively short period as planned. Nevertheless, the organizations failed to achieve a high level of strategic implementation quality due to the inability to identify and address one or (often) more of the TIF elements (Table 2) in satisfactory and consistent ways.

Berente and Yoo (2012) describe how governance issues at NASA hindered the use of an implemented ERP system and caused autonomous behaviors (resistance). Both Lyytinen et al. (2009) and Utesheva et al. (2016) describe cases where an organization took years to adjust its business model to achieve desired strategic objectives despite what appeared to be successful initial technical implementations of technologies.

Quadrant 4: the high-high quadrant

The high-high quadrant of Table 13 represents the optimal case where an organization achieves high levels of technical installation quality, and strategic installation quality. Thus, the organization succeeds in achieving its desired strategic objectives in a reasonable time. Ngwenyama and Nielsen (2014) show how an implementation team succeeded in both facets. The team achieved the desired installation quality and designed and enacted a coordinated strategy of organizational influence to achieve the strategic objectives. Furthermore, the team overcame several challenges, including strategic diffusion, leadership, and communication and interaction (Table 12). Tian and Xu (2015) provide another example of achieving the strategic objectives and technical installation quality. They conclude that ERP systems implemented with higher quality functionalities and greater scope were associated with lower firm risk than ERP systems implemented with limited functionalities and scope.

Table 14 lists the percentage of TIF elements per success quadrant. The table shows that there is not much difference in the distribution of challenges based on the quadrant of success. Consequently, what distinguishes those organizations that end up in the low-low quadrant from those that move toward the high-high quadrant does not lie in the distribution of challenges. It is rather directly associated with how organizations identify and deal with the TIF challenges, as seen in the following section.

4.4.2 From the low-low to the high-high quadrants

Organizations that achieve successful disruptive technology implementation appear to have two distinguishing features from those that fail: the ability to identify and systematically deal with the TIF challenges, and the ability to deal with these challenges in a holistic rather than isolated way. First, successful organizations in the high-high quadrant appear to systematically and often pre-emptively identify potential TIF challenges, enact plans and metrics to deal with these challenges, and react swiftly as additional challenges appear during the implementation. This is not what we observed in organizations in the low-low quadrant. These organizations often fail to identify potential challenges, do not employ sufficient metrics to address them, and underestimate the impact of their failure to act on the overall implementation success.

Table 14. Percentage of TIF Elements per Quadrant

Quadrant	Implementation quality		Number of articles	Total number of TIF elements	Percentage of TIF elements per quadrant			
	Technical	Strategic			Structural	Strategic	Interpersonal	External
1	Low	Low	6	11	27%	27%	45%	0%
2	Low	High	2	2	50%	0%	50%	0%
3	High	Low	15	24	17%	25%	50%	8%
4	High	High	11	19	21%	21%	58%	0%

Second, organizations in the high-high quadrant do not deal with the challenges in isolation. In other words, these organizations understand the interaction between the challenges—responding to one challenge appropriately may necessitate addressing the fallout in other challenges. Thus, their implementation plans involve addressing and responding to several challenges simultaneously. In contrast, organizations in the low-low quarter tend to deal with each challenge in isolation without addressing the potential consequences of these actions on the other challenges.

Tables 15, 16 and 17 provide examples of how organizations in the low-low and the high-high quadrants reacted to each one of the internal TIF challenges (Figure 1). In general, successful organizations in the high-high quadrant approached disruptive technology implementation as a strategic rather than tactical initiative, gave the technical and strategic aspects sufficient attention, installed technology gradually, rolled out technology features in phases accompanied by user training, and acted swiftly to address any technical instability (e.g., Abraham & Junglas, 2011; Chan et al., 2011; Orlikowski, 1996; Singh et al., 2011).

Furthermore, successful organizations adopted thorough and detailed planning that included multiple stakeholders, proactive and preemptive targeting of the TIF elements and their interactions and addressed the challenges systematically. The organizational leadership in the high-high quadrant was actively involved throughout the implementation process, and often planned and executed staged and gradual implementation creating “some good wins to show” the stakeholders (Abraham & Junglas, 2011, p. 184).

A consistent feature of organizations in the high-high quadrant is the ability to deal with the interaction between the challenges. The seven internal TIF challenges (Figure 1) are not isolated but rather joined with fuzzy borders. Any changes to organizational structure, for example, may impact control, leadership, decision-making, communications, and resistance. Similarly, changes in leadership, as another example, may affect strategic consensus, decision-making, strategic diffusion, control, and autonomous behaviors. Thus, dealing with one or two challenges in isolation is not sufficient.

Table 15. Examples: Structural Challenges in the Low-Low and the High-High Quadrants

TIF Element	Low-low quadrant	High-high quadrant
Organizational Structure	“Misalignment problems are the most difficult challenges in ERP implementation, given the complex and integrative nature of the ERP system.” (Wei et al., 2005, p. 332). “Resolving misalignment problems, however, is a complicated task involving the mutual adaptation between an ERP system and the processes and structures of the adopting organization.” (Wei et al., 2005, p. 332)) “As illustrated by the case, change management should be a critical issue in ERP implementation. The cascading nature of misalignment and change suggests that managers should not underestimate the efforts required for managing change.” (Wei et al., 2005, p. 332)	“We found that the team initially experienced significant misalignments among the pre-existing organizational environment, group, and technology structures. To resolve these misalignments, the team modified the organizational environment and group structures, leaving the technology structure intact. However, as the team proceeded, a series of events unfolded that caused the team to reevaluate and further modify its structures. This final set of modifications involved reverting back to the pre-existing organizational environment, while new technology and group structures emerged as different from both the pre-existing and the initial ones.” (Majchrzak et al., 2000, p. 569)
Control Mechanisms	“This [study] finding is consistent with previous studies asserting that actors cannot anticipate many of the technology-caused organizational effects (Besson & Rowe, 2001), and that trying to control certain effects will induce other unpredictable impacts (Markus, 1994). The ERP implementation process appears discontinuous because the change drivers are inconsistent and to some extent contradictory across project phases.” (Wei et al., 2005, p. 333)	“Sentara used the IS implementation to break open the organization and reveal its inner workings. This instituted a paradigm shift towards multidisciplinary care delivery that was unconfined by the location of the provider [effectively changing the control mechanisms]. The understanding that having access to the same comprehensive information across all units, as a means for coordinating care, proved to be essential for management.” (Abraham & Junglas, 2011, p. 188)

For instance, Chan et al. (2011, p. 534) described how leadership acted during the planning phase stating "[It] was made clear from the very beginning [that] permanent officers don't [have to] worry [as] we're not going to retrench [them]. But there would be changes in the way they work. And the benefits of e-filing were emphasized again and again." But these communications were followed during the operational phase with other measures to understand and address a potential autonomous behaviors challenge. Specifically, "the CEO took the initiative to organize a series of 'viewpoint' sessions with the line officers in the absence of middle managers so that she can get a better sense of the morale as well as the challenges of her officers." Consequently, the CEO managed to eliminate many of the challenges one by one. Addressing TIF challenges happened in parallel to addressing technical installation issues. That is, "[b]esides addressing the concerns of the staff and the external users, the senior management also stepped in to deal with the technical instability. Post-mortem meetings were called every evening where the senior management from AA, the vendor and the common ICT infrastructure project team were all represented. The focus of these meetings was directed at resolving the system instability" (Chan et al., 2011, p. 535).

The above discussion leads us to propose:

P5. Organizations that identify potential TIF challenges and eliminate them proactively through planning, or systematically as they appear during implementation, have a higher chance of achieving successful disruptive technology implementation.

P6. Organizations that not only address individual TIF challenges systematically, but also deal with their interactions, have a higher chance of achieving successful disruptive technology implementation.

Table 16. Examples: Strategic Challenges in the Low-Low and the High-High Quadrants

TIF Element	Low-low quadrant	High-high quadrant
Strategic Consensus	Implementation was run as a project. A project charter and group were established, and a series of information and configuration meetings were held. System functionality is limited due to the collapse of project organization, heavy workload and scarcity of resources, divided loyalties, internal conflicts, and delays in suppliers' deliveries. The standardized IHIS was not especially well-suited to Faroese work practice resulting in continuing configuration difficulties. Some influential groups of users (e.g., the medical consultants) were opposed to the project and there were major unresolved issues with data protection & patient information security. (Schlichter & Rose, 2013, p. 461)	"The difference in healthcare organizations, despite having paid employees, is that these clinicians, physicians, nurses, etc. are credentialed, allotting them autonomy to various degrees for how they deliver care. In essence, the CIO understood that the planning activities for the IS implementation would require a concerted effort that could not be envisioned as an IT sponsored project or even a top-down initiative. The process involved would require finesse and would be impacted by a number of social and political dynamics through the entire implementation effort." (Abraham & Junglas, 2011, p. 181)
Strategic Diffusion	At Bank1, the architects did not make efforts to build a sense of joint enterprise with their business and technology stakeholders and seemed to assume that it was not important to do so. For example, they stated: "Our role is first and all, to define the technology components and the implementation plans. That's all we do … Irrespective of what the business wants, we build technology capabilities. (B1-A1)." (Dale & Scheepers, 2019, p. 14)	"At Bank2, the architects worked closely with business and technology stakeholders to build a sense of joint enterprise. To help them select the appropriate systems, the architects collaborated with senior executives and other representatives from each business division to develop strategic business plans for future products, customer services, and business processes." (Dale & Scheepers, 2019, p. 14)

Table 17. Examples: Interpersonal Challenges in the Low-Low and the High-High Quadrants

TIF element	Low-low quadrant	High-high quadrant
Leadership & Decision-making	"In late 2007, the project organisation began to collapse. Some influential groups of users (e.g., the medical consultants) were opposed to the project and there were major unresolved issues with data protection and patient information security. A system upgrade was available but there was a conflict between ministry and supplier over who should pay for it. The surgical ward decided that the IHIS could not be used in its present configuration and the project manager resigned, blaming the high workload and the level of conflict." (Schlichter & Rose, 2013, p. 461)	"During the planning phase: leadership took several pre-emptive actions to address all potential issues that challenges the implementation. Similarly, during the operational phase, leadership also acted quickly. For instance, sensing the ominous situation, the CEO of AA together with other members of the senior management team immediately intervened and joined their front-line officer in placating the external users." (Chan et al., 2011, p. 534).
Communication & Interaction	"Recognising the difficulties, the hospital management confirmed its commitment to the project and demonstrated ownership of the implementation project. The project steering committee was reorganised and begun to meet regularly. Both the project and the principal supplier found ways to staff the project with people with more relevant backgrounds, who were better able to relate to user work practice and concerns." (Schlichter & Rose, 2013, p. 464)	"To realize the digital transformation strategy, a dedicated digital transformation unit (DTU) was created. This DTU would operate separately and autonomously from the IT department, have its own staff, and acts as a think tank as well as an internal service unit for the organization. Effectively communicating and directing the implementation project." (Chanias et al., 2019, p. 23)
Autonomous Behaviors	"In this case, narrative analysis has shed light on how a system of technical surveillance designed to routinize and formalize aspects of a social system was undermined and subverted by the determined efforts of individuals acting to protect their task discretion and functional autonomy." (Brown, 1998, p. 53)	"Early in the project planning cycle, the software process improvement group realized that, to successfully transform ITC's project management practices [eliminating autonomous behaviors], they had to enact a coordinated organizational influencing strategy. Eventually, they defined and evolved a programme of six core activities for achieving the goal of transforming project management practices across ITC." (Ngwenyama & Nielsen, 2014, p. 210)

4.4.3 Commonly encountered technical installation challenges

Although it is not realistic to expect management scholars to articulate and discuss technical installation challenges, it is important, however, to at least enquire about and list these challenges in their implementation studies. Besides, many management and information systems scholars have technical and engineering backgrounds that afford them the capacity to articulate and explain these technical challenges. Understanding these challenges allows organizations to better plan their disruptive technology implementations and prepare contingency plans to address these challenges as they come. Furthermore, accumulating knowledge about the technical challenges, allows management scholars to come up with a similar framework to TIF.

Several technical challenges appeared in the examined literature. These challenges may be classified into two broad categories: challenges endemic to the technology and challenges related to the installation environment. On the endemic to the technology side, the existence of fragmented and insular existing information systems in combination with old and manual processes represents a major challenge to disruptive technology implementation (Abraham & Junglas, 2011). Infrastructure incompatibility (legacy systems) with the new system, technical instability of the new system, unproven technology, low efficiency in handling large numbers of transactions, failure of the system to work as expected, and not being a user friendly system are some common examples (e.g., Chan et al., 2011; Chanias et al., 2019; Du et al., 2019; Majchrzak et al., 2000).

On the installation environment side, the technical complexity of the new systems appears often (e.g., Du et al., 2019). This challenge gets exacerbated when the technical department in charge of the installation lacks the competencies, the willingness, or both to handle the unfamiliar complexity of the disruptive technology at hand. In some cases, the technical department lacks advanced platform knowledge and an appropriate external IT service provider (Chanias et al., 2019). In contrast, the technical department in charge of the installation may have the competencies needed but be overwhelmed with extensive customization in some areas (Staehr, 2010), or simply not be equipped to handle the size of the project given the limited resources, the installation timeframe, or the desired functionalities that often evolve with the implementation (Dale & Scheepers, 2019; Du et al., 2019).

Combining the technical challenges (both endemic to the technology and those related to the installation environment) with the TIF challenges create an environment that leads to unsuccessful disruptive technology implementation in organizations (quadrants 1 and 3). Some organizations work around the technical installation challenges by gradually introducing the technology (Singh et al., 2011) or experimenting with the technology before implementing it on a wider scale (Orlikowski, 1996). Other organizations work around the technical installation challenges by deploying the technology in pilot projects or in some select departments before making it mandatory for the whole organization (Dale & Scheepers, 2019). In these four work-around measures, organizations resolve the majority of the technical challenges before officially adopting and deploying the technology at a wider scale—committing the organization to the disruptive technology.

5 Conclusions

This paper is an attempt to bridge “an enormous gulf between two audiences” (Peters & Thomas, 2020, p. 237): managers who care deeply about how to successfully implement disruptive technologies, and academics who have done so much to enrich our understanding of the challenges facing those managers. We set out to answer two questions: how do incumbent organizations implement disruptive technologies successfully? And, does the implementation of disruptive digital technologies differ from that of other disruptive technologies? To answer these questions, we conducted a structured and systematic literature review (Webster & Watson, 2002) and examined 139 empirical articles published in the management and information systems leading journals.

Successful technology implementation, as a field of scholarship, lacks a theory—perhaps because of its wide and eclectic roots. The theory of disruptive innovation is often invoked when studying disruptive technologies. Unfortunately, this theory is not concerned with how incumbent organizations implement disruptive technologies successfully, but rather with how new technologies “shake up an industry and alter its competitive patterns” (Christensen et al., 2018, p. 1044). Consequently, we need a theory to help us explain and predict (Gregor, 2006) why and how some organizations succeed in implementing disruptive technologies and others fail. The TIF developed in this paper and the propositions listed in the preceding sections are preliminary steps toward building such a theory.

We coded the literature using three criteria: technological category, challenges to successful implementation, and degree of implementation success. First, we classified disruptive technologies into traditional (non-IT), function-IT, network-IT, enterprise-IT, and digital technologies (Table 1). Second, by relying on the strategy, management, and information systems literatures, we developed a comprehensive framework, called TIF, that incorporates the challenges, inhibitors, and enablers of technology implementation in organizations (Figure 1). Finally, we argued that successful technology implementation requires success on two fronts: technical installation and strategic implementation (Figure 5).

The TIF categorizes organizations’ implementation challenges into four broad categories: structural, strategic, interpersonal, and external. These broad categories are further divided into nine leaf elements (Table 2): organizational structure, control mechanisms, strategic consensus, strategic diffusion, leadership and decision making, communication and interaction, autonomous behaviors, environmental or ecosystem, and other external elements. Technical installation quality requires overcoming challenges endemic to the technology and challenges related to the installation environment. Figure 6 illustrates the relationships among the various constructs discussed in this research.

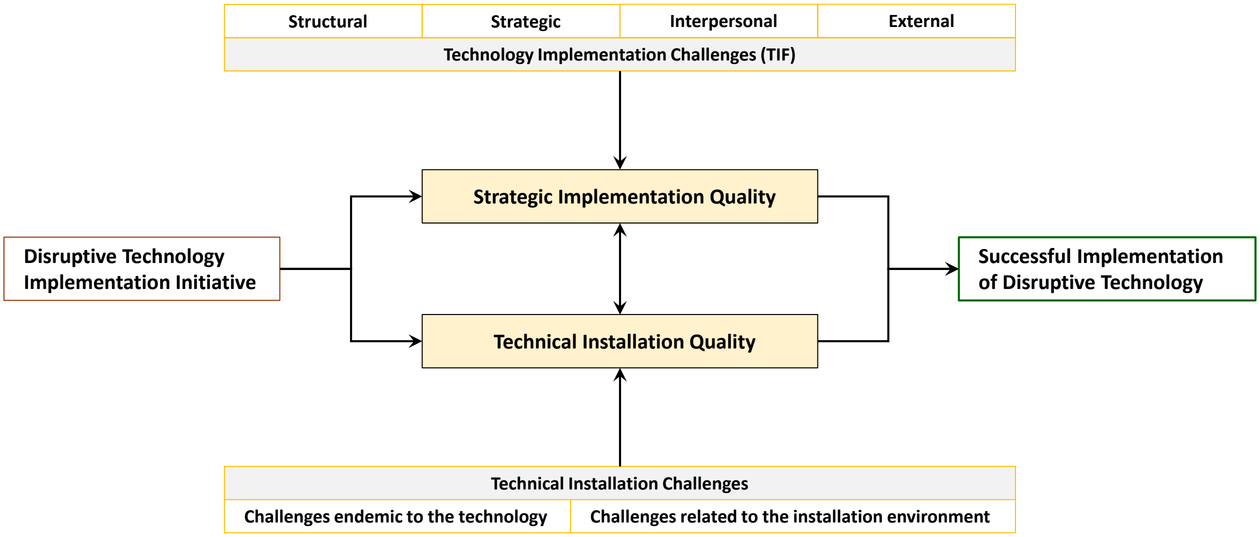

Figure 6. Technology Implementation Success Constructs and Relationships

5.1 Theoretical Implications

Our review and coding of the literature led to several observations that have implications for theory. First, the nine leaf elements of the TIF suggest that disruptive technology implementation is an organizational or multilevel phenomenon. Yet almost 50% of the literature focuses on other levels of analysis (Figure 2). For many organizations, disruptive technology implementation is a complex process that requires overcoming several internal and external barriers; comes with major costs and risks; and, in some cases, represents a make or break endeavor (e.g., Christensen et al., 2018; Danneels, 2004; Eggers & Park, 2018; Lavie, 2006). Consequently, studying technology implementation at the individual, project, or industry level, though valuable, provides only a partial understanding of the factors inhibiting successful implementation.

Second, the technical characteristics of disruptive technologies are important and affect the nature of the challenges facing organizations (Figure 3). Research suggests that neither the technical aspect nor the human aspect of technology is, by itself, sufficient to explain the outcome of technology implementation, and hence we need a reconceptualization of technology that takes both perspectives into account (Orlikowski, 1992). Nevertheless, the articles in our literature review rarely provide details about the technical characteristics of the implemented technologies (Table 10). Consequently, the pendulum has swung too far in the direction of focusing on human aspects while ignoring the technical aspects.

Third, although a small percentage of the articles discuss challenges that belong to two, three-, or four-leaf elements in our TIF, the majority are either silent or discuss challenges that belong to a single leaf element. Thus, a holistic or gestalt perspective is missing from the literature (Gottschalk, 1999). An in-depth examination of one or two challenges can help advance knowledge about these challenges. Nevertheless, the interaction among challenges, which is almost absent from the literature, represents an important undertheorized area.

Various implementation challenges as identified by our technology implementation framework (TIF) can now emerge from obscurity to 'marginal consciousness' (Gurwitsch, 1985). Influenced by what he perceived as incomplete conceptualization in Gestalt philosophy, Aron Gurwitsch developed the concept of marginal consciousness. According to Gestalt principles, we group similar elements, create patterns, and simplify images by glossing over the details of the individual elements when perceiving a whole picture or a phenomenon. Perception is often split between a focal figure and the background that becomes vague. In contrast, Gurwitsch (1985) argued that in addition to the focal figure and the background, perception includes another crucial element: marginal consciousness. That is, additional objects that stay at the margin of our attention, can quickly be brought forward to conscious attention if we were aware of them. This research provides this awareness.

Fourth, implementing digital technologies is not fundamentally different from implementing other disruptive technologies, but the unique characteristics of digital technologies provide options that may eliminate many of the challenges. Specifically, digital technologies provide flexibility and alternative collaboration mechanisms that ease the challenges associated with implementing them. Furthermore, digital technologies can be introduced gradually in small steps and can be combined from different sources. Thus, organizations can easily adjust their implementation plans in response to the challenges faced within or outside their borders. Furthermore, disruptive digital technologies allow quick adjustment to the organizations' business models and timely response to changing competitive market demands.

However, the same unique characteristics of digital technologies that may eliminate many of the challenges may open doors for other challenges. For instance, an incremental adoption of these technologies can allow sufficient time for resistance to diffuse. In contrast, the speed with which these technologies may be implemented can jeopardize other organizational processes intended to eliminate other potential implementation challenges by adjusting, for example, the organization's structure or control mechanisms.

Finally, how to measure disruptive technology implementation success has not received sufficient attention despite its importance. We argue that successful disruptive technology implementation requires achieving both desired technical installation quality and a high level of strategic implementation quality. A small number of the articles (33/139) provide conclusive details to judge these two facets of success. What is interesting is that in some cases where the desired technical installation quality was achieved, other challenges (structural, strategic, interpersonal, and external) caused the organization to suffer an overall failure of its implementation. In contrast, in some (rare) cases, the implementation team failed technically to implement the technology as originally planned, yet creative solutions and workarounds allowed the disruptive technology to be used to achieve the organization's desired objectives. Both cases are interesting from theoretical and practical perspectives and represent innovations worthy of future research.

Our analysis of the literature has led to the following propositions:

- *P1. Organizations that address the TIF challenges at multiple levels (individual, project, organization, industry) have a higher chance of achieving successful disruptive technology implementation.*
- *P2. Organizations that recognize the link between the nature of the disruptive technology and the pattern of the implementation challenges have a higher chance of identifying and eliminating these challenges.*
- *P3. Organizations implementing disruptive digital technologies improve their implementation success by capitalizing on the four unique characteristics of digital technologies: editability, modifiability, interactivity, and distributedness.*
- *P4. Organizations that pay close attention to technical installation quality and strategic implementation quality have a higher chance of achieving successful disruptive technology implementation.*
- *P5. Organizations that identify potential TIF challenges and eliminate them proactively through planning, or systematically as they appear during implementation, have a higher chance of achieving successful disruptive technology implementation.*
- *P6. Organizations that not only address individual TIF challenges systematically, but also deal with their interactions, have a higher chance of achieving successful disruptive technology implementation.*

These propositions address both the explaining and predicting aspects of theory in information systems (Gregor, 2006), and hence may be accepted as a current disruptive technology implementation success theory pending further testing.

5.2 Practical Implications

We see several practical implications for this research. The literature does not provide a clear picture of the strategic deliberations that went into the decisions to implement the disruptive technologies. Such strategic deliberations often happen a few months prior to the initiation of any disruptive technology implementation project. We also see little evidence to support articulate identifications of the potential challenges and the existence of concrete plans to address these challenges proactively. In contrast, leaders and managers appear to focus on the resources and capabilities that these technologies bring to their organizations. The technical installation challenges of new systems and technologies often take precedence over the more subtle challenges identified in our TIF. Evidence from this literature review indicates that many organizations prematurely assume implementation success once these systems and technologies are tested. In fact, many of the implementation challenges start to appear immediately after employees are directed to use these technologies (Figure 5).

The TIF (Figure 1) includes four broad categories describing challenges and nine more granular elements —structural (organizational structure, control mechanisms), strategic (strategic consensus, strategic diffusion), interpersonal (leadership and decision making, communication and interaction, autonomous behaviors), and external (environmental or ecosystem, other external elements). The TIF can be used by managers and consultants to advise organizations during the planning or implementation of disruptive technologies. Specifically, many of the challenges listed in the TIF can be systematically eliminated by careful planning and proactive leadership measures. Furthermore, some of the unique insights identified by scholars examining digital technology implementation, and summarized in this paper, may provide useful suggestions to practitioners and leaders involved in implementing these technologies.

For practitioners, combining Figure 1 and Figure 3 provides a road map to successful disruptive technology implementation planning. Figure 3 shows a relationship between the category of disruptive technology and the dominant challenges associated with that technology. While the interpersonal challenges must be carefully addressed in every plan to implement a disruptive technology, every technological category requires careful attention to other sets of challenges. For instance, implementing traditional (non-IT) technologies requires almost equal attention to the structural, strategic, and external challenges. In contrast, implementing function-IT technologies appears to necessitate more but equal attention to the structural and strategic challenges as the external challenges are minimal. For network-IT and enterprise-IT, the interpersonal challenges represent over half of the challenges. But attention to the structural challenges is more important in the first one, while equal attention to the structural, strategic, and external is more important in the second one. Finally, implementing digital technologies requires strong attention to the structural and strategic challenges.

5.3 Limitations and Future Directions

This study has limitations. First, we limited our sample to articles published in the top management and information systems journals. Other venues, including practitioners' journals and conference proceedings, may provide additional valuable insights. Second, we limited our initial time frame to ten years (January 2010 - January 2020). Although both limitations reduced the size of our literature sample, we expanded our selection by including additional highly cited articles regardless of their publication venue or time. Third, we relied on an inductive/deductive approach to code the literature and create the concept matrix (Webster & Watson, 2002). Specifically, we used an inductive approach to identify the different enablers and inhibitors to a successful implementation of disruptive technologies and to create the TIF. We continuously revisited the TIF and added more details and distinctions to overcome the limitations of the inductive approach. A purely deductive approach may result in a different framework with different leaf elements, but this is an area for future research. Finally, we followed a deductive approach to code the categories of implemented technologies.

Our paper is but a small step toward understanding disruptive technology implementation in organizations. Challenges remain. Future research can address areas where our knowledge is limited. Specifically, scholars may start a research program focused on examining the strategic deliberations that go into the decisions to implement the chosen disruptive technologies in organizations. Such a program may identify why leaders underestimate the potential TIF challenges focusing instead on the capabilities gained from the implementation. In addition, scholars may devise tools to improve how firms address the risks associated with technology implementation before the initiation of these projects. Future research may also pay attention to the technical challenges facing organizations. Such research may categorize the technical challenges in a similar way to our TIF. Furthermore, scholars can address the challenges from a holistic perspective by examining the interaction of several challenges or by paying closer attention to the interaction between technical and social challenges. Finally, more work is needed to advance our knowledge about how digital technologies may be implemented differently, considering their unique characteristics.

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Appendix A: Sources of the TIF Leaf Elements

Table A1. TIF: Major Categories, Leaf Elements, and Sources

Category	Leaf element	Sample literature
Structural	Organizational Structure	Barley (1986), Barley (1990), Berg (2001), Dhillon et al. (2011), Kapoor & Adner (2012), Kranz et al. (2016), Leonard & Higson (2014), Majchrzak et al. (2000), Orlikowski (1992), Orlikowski (1993), Orlikowski (1996), Rodón & Sesé (2010), Wei et al. (2005), Xin & Choudhary (2019)
	Control Mechanisms	Abraham & Junglas (2011), Ansari et al. (2016), Arvidsson & Mønsted (2018), Berente & Yoo (2012), Bernroider (2013), Chua et al. (2012), Conboy (2010), Cozzolino et al. (2018), Danneels (2011), Glaser (2017), Gottschalk (1999), Grant (2003), Gregory et al. (2018), Klingebiel & De Meyer (2013), Majchrzak et al. (2000), Orlikowski (1993), Utesheva et al. (2016), Wei et al. (2005)
Strategic	Strategic Consensus	Bala & Venkatesh (2016), Canato et al. (2013), Dhillon et al. (2011), Du et al. (2019), Grant (2003), Henfridsson et al. (2014), Huy Corley & Kraatz (2014), Kammerlander et al. (2018), Klein & Sorra (1996), Koh et al. (2011), Levina & Vaast (2005), Schlichter & Rose (2013), Tripsas (2009), Utesheva et al. (2016), Venkatesh et al. (2016), Wagner et al. (2012)
	Strategic Diffusion	Abraham & Junglas (2011), Bengtsson & Ågerfalk (2011), Canato et al. (2013), Cavusoglu et al. (2010), Dale & Scheepers (2019), Dong et al. (2009), Gottschalk (1999), Grant (2003), Griffith & Northcraft (1996), Grover & Kohli (2013), Huy (2011), Karahanna et al. (1999), Lanzolla & Suarez (2012), Leonardi (2013), Leonardi et al. (2016), Ngwenyama & Nielsen (2014), Wastell (2006)
Interpersonal	Leadership & Decision-Making	Agarwal et al. (2011), Bernroider (2013), Chan et al. (2011), Dale & Scheepers (2019), Heracleous & Barrett (2001), Lanzolla & Suarez (2012), Li & Madnick (2015), Lyytinen et al. (2009), Ng & Gable (2010), Ngwenyama & Nielsen (2014), Power & Gruner (2017), Schlichter & Rose (2013), Snider et al. (2009), Staehr 2010),
	Communication & Interaction	Abraham & Junglas (2011), Aiman-Smith & Green (2002), Attewell (1992), Avgar et al. (2018), Canato et al. (2013), Chanias et al. (2019), Dong et al. (2009), Du et al. (2019), Edmondson et al. (2001), Faik & Walsham (2013), Glaser (2017), Griffith & Northcraft (1996), Hendricks et al. (2007), Henfridsson et al. (2014), Iannacci (2014), Jenkin & Chan (2010), Kahl & Grodal (2016), Khanna et al. (2016), Ko et al. (2005), Laumer et al. (2016), Leonard-Barton (1988), Lyytinen et al. (2009), Majchrzak et al. (2000), Ngwenyama & Nielsen (2014), Salomon & Martin (2008), Schlichter & Rose (2013), Shepherd et al. (2014), Singh et al. (2011), Snider et al. (2009), Sykes (2015), Sykes & Venkatesh (2017), Sykes et al. (2014), Tian & Xu (2015), Tyre & Hauptman (1992), Venkatesh et al. (2011), Wagner et al. (2010), Webster (1995), Yeow et al. (2018)
	Autonomous Behaviors	Alvarez (2008), Arvidsson et al. (2014), Azad & Faraj (2011), Berente & Yoo (2012), Berg (2001), Brown (1998), Canato et al. (2013), Dhillon et al. (2011), Doolin (2004), Hardy & Thomas (2014), Huy (2011), Huy et al. (2014), Jiang et al. (2000), Kannan-Narasimhan & Lawrence (2018), Kim & Kankanhalli (2009), Klaus & Blanton (2010), Klaus et al. (2010), Lapointe & Rivard (2005), Lapointe & Rivard (2007), Laumer et al. (2016), Lim et al. (2011), Markus (1983), Ozalp et al. (2018), Polites & Karahanna (2012), Schlichter & Rose (2013), Schultze & Orlikowski (2004), Wagner et al. (2010)
External	Environmental or Ecosystem	Brown (1998), Canato et al. (2013), Guth & MacMillan (1986), Laumer et al. (2016), Martinez-Simarro et al. (2015), Snider et al. (2009), Stieglitz et al. (2016)
	Other External	Berente & Yoo (2012), Chan et al. (2011), Chanias et al. (2019), Kelly & Amburgey (1991), Polites & Karahanna (2012)

Appendix B: Sources of the Technology Implementation Success Matrix

Table B1. Disruptive Technology Implementation Success Matrix

			Strategic implementation quality	
			Low	High
Technical installation quality	**High**		**Quadrant 3**: Number of Papers: 15	**Quadrant 4**: Number of Papers: 11
		Traditional technologies	0	0
		Function IT	3 Doolin (2004), Griffith & Northcraft, (1996), Leonardi (2013)	1 Orlikowski (1996)
		Network IT	1 Schultze & Orlikowski (2004)	1 Majchrzak et al. (2000)
		Enterprise IT	9 Arvidsson et al. (2014), Berente & Yoo (2012), Grant (2003), Klaus et al. (2010), Leonardi et al. (2016), Lyytinen et al. (2009), Venkatesh et al. (2011), Wagner et al. (2010), Webster (1995)	6 Abraham & Junglas (2011), Chan et al. (2011), Ngwenyama & Nielsen (2014), Singh et al. (2011), Staehr (2010), Tian & Xu (2015)
		Digital technologies	2 Kranz et al. (2016), Utesheva et al., (2016)	3 Chanias et al. (2019), Dale & Scheepers (2019), Du et al. (2019)
	Low		**Quadrant 1**: Number of Papers: 6	**Quadrant 2**: Number of Papers: 2
		Traditional technologies	0	0
		Function IT	0	1 Power & Gruner (2017)
		Network IT	0	0
		Enterprise IT	5 Brown (1998), Rodón & Sesé (2010), Schlichter & Rose (2013), Venkatesh et al. (2016), Wei et al. (2005)	0
		Digital technologies	1 Dale & Scheepers (2019)	1 Arvidsson & Mønsted (2018)

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