The technology-organization-environment framework

Article · January 2011

1 author:

Jeff Baker
American University of Sharjah

Chapter 12
The Technology–Organization–Environment Framework

Jeff Baker

Abstract This chapter describes the Technology–Organization–Environment (TOE) framework. It begins by presenting a description of the TOE framework and its constructs. Next, a brief review of studies that have used the TOE framework is provided. In this review, an emphasis is placed on noting the type of innovation that is being adopted in each study. Also, the different ways in which the framework has been adapted for various adoption contexts are highlighted. Finally, directions for future research with the TOE framework are described. In spite of this framework's stability since its initial development, many avenues for evolution and development appear promising.

Keywords Adoption of innovations, • Diffusion of innovations • Technology-Organization-Environment framework • Technology adoption

Abbreviations

CRT	Cathode ray tube
DOI Theory	Diffusion of innovations theory
EDI	Electronic data interchange
ERP	Enterprise resource planning
IOS	Interorganizational systems
IS	Information systems
RBV	Resource-based view
RFID	Radio-frequency identification
SCM	Supply chain management

J. Baker (✉)
Department of Management Information Systems, School of Business and Management, American University of Sharjah, P.O. Box 26666 Sharjah, United Arab Emirates
e-mail: jbaker@aus.edu

Y.K. Dwivedi et al. (eds.), *Information Systems Theory: Explaining and Predicting Our Digital Society, Vol. 1*, Integrated Series in Information Systems 28,
DOI 10.1007/978-1-4419-6108-2_12,

TAM	Technology acceptance model
TAM2	Technology acceptance model version 2
TOE	Technology–organization–environment framework
TPB	Theory of planned behavior
UTAUT	Unified theory of acceptance and use of technology

12.1 The Technology–Organization–Environment Framework [AU1]

The technology–organization–environment (TOE) framework is described in Tornatzky and Fleischer's *The Processes of Technological Innovation* (1990). The book describes the entire process of innovation – stretching from the development of innovations by engineers and entrepreneurs to the adoption and implementation of those innovations by users within the context of a firm. The TOE framework represents one segment of this process – how the firm context influences the adoption and implementation of innovations.

The TOE framework is an organization-level theory that explains that three different elements of a firm's context influence adoption decisions. These three elements are the *technological context*, the *organizational context*, and the *environmental context*. All three are posited to influence *technological innovation*.

12.1.1 The Technological Context

The technological context includes all of the technologies that are relevant to the firm – both, technologies that are already in use at the firm as well as those that are available in the marketplace but not currently in use. A firm's existing technologies are important in the adoption process because they set a broad limit on the scope and pace of technological change that a firm can undertake (Collins et al. 1988). Innovations that exist but are not yet in use at the firm also influence innovation – both by demarcating the limits of what is possible as well as by showing firms ways in which technology can enable them to evolve and adapt.

Within the group of innovations that exists outside the firm are innovations of three types, those that create incremental, synthetic, or discontinuous changes (Tushman and Nadler 1986). Innovations that produce incremental change introduce new features or new versions of existing technologies. These incremental innovations represent the least amount of risk and change for the adopting organization. Examples include the transition from cathode ray tube (CRT) computer monitors to liquid crystal display (LCD) monitors, or an upgrade from one version of enterprise resource planning (ERP) system to a newer version of the same system. Innovations producing synthetic change represent a middle point of moderate change, where existing ideas or technologies are combined in a novel manner. An example is universities' delivery of course content via the Internet. No new technologies – in recording, storage, or transmission are used – neither is there necessarily an innovation in course content. Thus, existing technologies are combined in a novel way to innovate. Innovations that produce a discontinuous change – which have been referred to as “radical” innovations (Ettlie et al. 1984) – represent significant departures from current technology or processes. Examples include the adoption of bar-code scanning in the grocery industry in the 1970s and 1980s, the change from mainframes to PCs at many corporations in the 1980s, or the shift to cloud computing that began in the early 2000s.

Industries that are characterized by technological innovations that cause incremental and even synthetic change allow a measured pace of adoption. In contrast, industries that are characterized by technological innovations that produce discontinuous change require firms to make quick and decisive adoption decisions to maintain and enhance competitive standing. When evaluating technologies that will cause discontinuous change, firms must also consider whether these technologies are “competence-enhancing” or “competence-destroying” (Tushman and Anderson 1986). Competence-enhancing innovations enable firms to gradually change as they build upon their expertise, while competence-destroying innovations render many existing technologies and many types of expertise obsolete. These discontinuous, competence-destroying innovations often cause major shifts in industries. For instance, the shift to cloud computing may ultimately prove to be a competence-destroying technology. Firms that have achieved a high level of expertise within their IT function may find that such a competency is no longer needed and no longer a source of competitive advantage. In contrast, the adoption of RFID technology appears to be competence-enhancing. Firms that have a demonstrated skill in tracking assets and resources – a skill that most likely relies on bar-coding technology – can build upon this competency. As they replace bar codes and optical scanners with RFID tags and digital RFID scanners, they can use the same databases to store item data and can find new efficiencies in business processes as manual scanning of bar codes becomes unnecessary.

In sum, organizations must carefully consider the type of organizational changes that will be created by adopting a new innovation. Some innovations will have a dramatic impact on the firm and the industry in which it competes, while others will have a relatively small impact.

12.1.2 The Organizational Context

The organizational context refers to the characteristics and resources of the firm, including linking structures between employees, intra-firm communication processes, firm size, and the amount of slack resources. There are several ways in which this context affects adoption and implementation decisions. First, mechanisms that link internal subunits of the organization or span internal boundaries promote innovation (Galbraith 1973; Tushman and Nadler 1986). The presence of informal linking agents – such as product champions, boundary spanners, and gatekeepers – is associated with adoption. Cross-functional teams and employees that have formal or informal links to other departments or to other value chain partners are additional examples of such mechanisms.

More broadly, organizational structure has been studied to identify its relationship to the innovation adoption process. Organic and decentralized organizational structures are associated with adoption (Burns and Stalker 1962; Daft and Becker 1978). Organizations with these types of structures emphasize teams, have a degree of fluidity in responsibilities for employees, and promote lateral communication in addition to communication along reporting lines. Other research on organizational structure indicates that while organic and decentralized structures may be best-suited to the *adoption* phase of the innovation process, mechanistic (rather than organic) structures, with their emphasis on formal reporting relationships, centralized decision-making, and clearly defined roles for employees, may be best-suited to the *implementation* phase of the innovation process (Zaltman et al. 1973).

Communication processes within the organizational context can also promote or inhibit innovation. Top management can foster innovation by creating an organizational context that welcomes change and is supportive of innovations that further the firm's core mission and vision (Tushman and Nadler 1986). Top management leadership behaviors and communication processes include describing the role of innovation within the organization's overall strategy, indicating the importance of innovation to subordinates, rewarding innovation both formally and informally, emphasizing the history of innovation within a firm, and building a skilled executive team that is able to cast a compelling vision of the firm's future.

Among the most frequently discussed factors within the organizational context that affect innovation, however, are slack and size. While much research indicates that slack promotes adoption (March and Simon 1958; Rogers 1995), additional work indicates that innovation can take place in the absence of this factor and that the presence of slack may not necessarily lead to technological innovation (Tornatzky et al. 1983). Thus, while slack is desirable and helpful, it is "neither necessary nor sufficient for innovation to occur" (Tornatzky and Fleischer 1990, p. 161).

Size is also widely studied, but a conclusive link between this factor and innovation does not exist. Larger organizations are generally more likely to adopt innovations (Cyert and March 1963; Kamien and Schwartz 1982; Scherer 1980), but much of this research has been criticized on the grounds that size is often a crude proxy for more specific and more meaningful underlying organizational factors such as the availability of specific resources (Kimberly 1976). Thus, a link between size and innovation cannot be conclusively established, and researchers argue for the use of more specific measures of organizational variables than simply the generic measure "size."

An example of a firm that was able to cultivate an organizational context that was receptive to the adoption of innovation is the motorcycle-maker, Harley-Davidson Motor Company (Austin et al. 2003). When the company was considering implementing a new supply chain management (SCM) system in the late 1990s, they deliberately assembled a project team that included key employees from different sites and different functions in the firm. They benefitted from a company structure where rigidly divided functional silos do not exist, but interlocking functional teams collaborate to make decisions and define strategy. Furthermore, the company values self-directed teams rather than formal hierarchy. And finally, a champion for the innovation, the CIO of the firm, was instrumental in the adoption of a new SCM system. This example illustrates one specific setting where the organizational context was particularly well-structured to promote the adoption of an innovation.

12.1.3 The Environmental Context

The environmental context includes the structure of the industry, the presence or absence of technology service providers, and the regulatory environment. Industry structure has been investigated in several ways. For instance, intense competition stimulates the adoption of innovation (Mansfield 1968; Mansfield et al. 1977). Also, dominant firms within the value chain can influence other value chain partners to innovate (Kamath and Liker 1994).

With regard to industry life cycle, it is argued that firms in rapidly growing industries tend to innovate more rapidly. In mature or declining industries, however, innovation practices are not clear-cut (Tornatzky and Fleischer 1990). Some firms use the decline of an industry to innovate through efficiency initiatives or by expanding into new lines of business. Other firms may avoid investment in innovation in an effort to minimize costs. Empirical work validating these assertions about the relationship between industry life cycle and the adoption of innovation remains to be carried out.

The support infrastructure for technology also impacts innovation. Firms that must pay high wages for skilled labor are often compelled to innovate through labor-saving innovations (Globerman 1975; Levin et al. 1987). The availability of skilled labor and the availability of consultants or other suppliers of technology services also fosters innovation (Rees et al. 1984).

Finally, government regulation can have either a beneficial or a detrimental effect on innovation. When governments impose new constraints on industry, such as requiring pollution-control devices for energy firms, innovation is essentially mandated for those firms. Similarly, stringent safety and testing requirements can retard innovation in numerous industries. For instance, in construction, where new materials must be extensively tested before they can be used, or in agriculture, where new varieties of crops must be patented and licensed, the cost of innovation can be quite high. Another example exists in banking, where privacy requirements may prevent banks from introducing new ways for customers to access their account information. Thus, government regulation can either encourage or discourage innovation.

In sum, these three elements – the technological, organizational, and environmental contexts – present "both constraints and opportunities for technological innovation" (Tornatzky and Fleischer 1990, p. 154). These elements influence the firm's level of technological innovation. Figure 12.1 depicts this framework visually.

12.2 The Technology–Organization–Environment Framework in Research

Extant research has demonstrated that the TOE model has broad applicability and possesses explanatory power across a number of technological, industrial, and national/cultural contexts. The TOE model has been used to explain the adoption of interorganizational systems (Grover 1993; Mishra et al. 2007), e-business (Zhu et al. 2003; Zhu

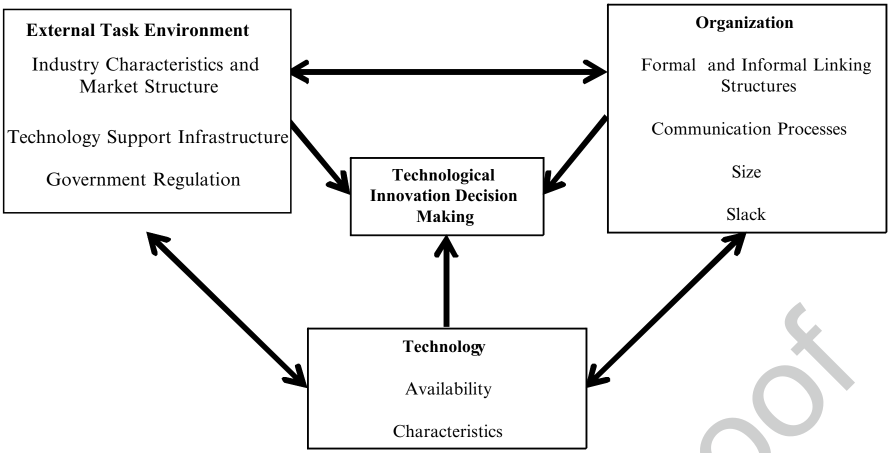

Fig. 12.1 The technology–organization–environment framework

and Kraemer 2005; Zhu et al. 2006b; Zhu et al. 2004), electronic data interchange (EDI) (Kuan and Chau 2001), open systems (Chau and Tam 1997), enterprise systems (Ramdani et al. 2009), and a broad spectrum of general IS applications (Thong 1999). The TOE model has been utilized to explain the adoption of innovations in a host of industries, including manufacturing (Mishra et al. 2007; Zhu et al. 2006b), health care (Lee and Shim 2007), retail, wholesale, and financial services (Zhu et al. 2006b). Furthermore, the TOE model has been tested in European, American, and Asian contexts, as well as in both developed as well as developing countries (Zhu et al. 2003; Zhu and Kraemer 2005; Zhu et al. 2006b, 2004). In each study, the three elements of technology, organization, and environment have been shown to influence the way a firm identifies the need for, searches for, and adopts new technology.

In each of the empirical studies that test the TOE framework, researchers have used slightly different factors for the technological, organizational, and environmental contexts. In essence, researchers have concurred with Tornatzky and Fleischer (1990) that the three TOE contexts influence adoption, but these researchers have then assumed that for each specific technology or context that is being studied, there is a unique set of factors or measures. For instance, in Zhu et al. (2004), the authors argue that one pertinent factor in the technological context that affects the adoption of e-business is "technology readiness." Similarly, these authors argue that "firm size," "global scope," and "financial resources" are the pertinent factors that should be studied to understand how the organizational context affects the adoption of e-business. Finally, the "regulatory environment" and "competition intensity" are relevant when researchers wish to understand how the environmental context influences the adoption of e-business. Different types of innovations have different factors that influence their adoption. Similarly, different national/cultural contexts and different industries will have differing factors as well. Thus, other research studies use different factors for the technological, organizational, and environmental contexts.

Table 12.1 lists these factors that compose the technological, organizational, and environmental context elements in each of the extant empirical studies. In this table, asterisks denote factors that were statistically significant predictors of adoption; plain text denotes a factor for which partial support was found, and italics denote that the factor was not statistically significant. This table also identifies the type of innovation that is being studied.

12.3 The Technology–Organization–Environment Framework in Future Research

To this point, the majority of the theoretical development that has taken place related to the TOE framework has been limited to enumerating the different factors that are relevant in various adoption contexts. No new constructs have been added to the framework. Little theoretical synthesis has occurred. Scant critique has been offered. Thus, the TOE framework has evolved very little since its original development. In this section, reasons for this lack of theoretical development will be presented, followed by directions for future research.

12.3.1 Reasons for Lack of Development

There may be multiple reasons for the relative lack of evolution and change in the TOE framework since its initial development. First, the TOE framework has been described as a "generic" theory (Zhu and Kraemer 2005, p. 63). This assessment seems appropriate considering that the theory has come to be used as a framework within which a host of various factors can be placed (as has been demonstrated in Table 12.1). The freedom to vary the factors or measures for each new research context makes the TOE framework highly adaptable. Thus, scholars have seen little need to adjust or refine the theory itself.

Second, the TOE framework may have seen relatively little evolution because it has been viewed as aligned with other explanations of innovation adoption – rather than offering a competing explanation to them. Tension between the TOE framework and other theories has been seen as slight, and this tension has, at this point, to be resolved by allowing the TOE framework to subsume competing ideas, rather than respond to them. For instance, it has been noted that the TOE framework is consistent with the theory of the diffusion of innovations (DOI) (Rogers 1995). The DOI adoption predictors, *individual leader characteristics* and *internal characteristics of organizational structure* are said to be comparable to the TOE's *organizational context* element. A similar renaming equates DOI's *external characteristics of the organization* with TOE's *environmental context*. Finally, Rogers's implicit emphasis on technological characteristics of the innovation has been said to equate with the TOE's *technological context* (Zhu et al.

Table 12.1 Summary of prior studies using the TOE framework

Reference and innovation	Technological context factors	Organizational context factors	Environmental context factors
Chau and Tam (1997)	Perceived barriers*	Satisfaction with existing systems*	*Environmental uncertainty*
	Perceived benefits	*Complexity of IT infrastructure*	
Open systems	*Perceived importance of compliance to standards, interoperability, and interconnectivity*	*Formalization on system development and management*	
Grover (1993)	Compatibility*	Size*	Role of IT*
	Complexity*	Strategic planning*	Management risk position*
Customer-based IOS	*Relative advantage*	Infrastructure*	Adaptable innovations*
		Top management support*	Technology policy
		Championship*	Customer interaction
		Centralization	Competitor scanning
		Formalization	Competition intensity
		Integration	Information intensity
		Implementation planning	Power
			Generic strategy
			Maturity
			Vertical coordination
Kuan and Chau (2001)	Perceived direct benefits*	Perceived financial cost*	Perceived industry pressure*
EDI	*Perceived indirect benefits*	Perceived technical competence*	Perceived government pressure*
Lee and Shim (2007)	Perceived benefits*	Presence of champions*	Performance gap*
RFID	Vendor pressure		Market uncertainty*
Mishra et al. (2007)	Procurement process digitization*	Diversity of organizational procurement knowledge	Suppliers' sales-process digitization*
Internet in procurement		Organizational perceptions of technological uncertainty	

Ramdani et al. (2009)	Relative advantage*	Top management support*	*Industry*
	Compatibility		*Market scope*
	Complexity	Organizational readiness*	*Competitive pressure*
Enterprise systems	Trialability*		*External IS support*
	Observability	*IS experience*	
		Size*	
Thong (1999)	Relative advantage of IS	Business size*	*Competition*
	Compatibility of IS	Employees' IS knowledge*	
IS	Complexity of IS	Information intensity	
		CEO's innovativeness	
		CEO's IS knowledge	
Zhu et al. (2003)	Technology competence (second-order construct composed of IT infrastructure, Internet skills, e-business know-how)*	Firm size*	Competitive Pressure*
E-business		Firm scope*	Consumer readiness (interactive construct composed of consumer willingness, Internet penetration)
			Lack of trading partner readiness
Zhu et al. (2004)	Technology readiness*	Firm size*	Regulatory environment*
		Global scope*	*Competition intensity*
e-business		Financial resources*	
Zhu and Kraemer (2005)	Technology competence*	Size*	Regulatory support*
e-business		Financial commitment*	Competitive pressure
		International scope	
(Zhu et al. 2006b)	Technology integration*	Firm size	Competition intensity
e-business	Technology readiness	Global scope	Regulatory environment
		Managerial obstacles	

2003, 2006a). Because these theories are described as markedly similar, the TOE framework has not been altered in response to DOI. Instead, researchers explain them as being closely related.

An example of the TOE framework subsuming a similar theoretical approach is seen in the blending of the TOE with a model of EDI adoption (Iacovou et al. 1995). The EDI adoption model was developed in a multiple case-study research program and explains that *perceived benefits*, *organizational readiness*, and *external pressure* predict the adoption of EDI. One study "integrates" the EDI adoption model of Iacovou et al. (1995) with the TOE framework (Kuan and Chau 2001, p. 509), another cites these models alongside each other as though they have the same predictors (Lee and Shim 2007), and others go even farther, stating that "following Tornatzky and Fleischer (1990), Iacovou et al., developed a model formulating three aspects of EDI adoption – *technological* factor, *organizational* factor, and *environmental* factor…" (Zhu et al. 2003, p. 253, emphasis in original – see also Zhu et al. 2004, p. 20). This is a particularly striking statement given that the EDI adoption model was developed independently of the TOE framework, with Iacovou et al. never referencing or citing TOE research. It is also striking in that Zhu et al. have described the EDI adoption model constructs in a way that makes them appear identical to the TOE elements. Similar statements about Iacovou et al.'s research supporting the TOE framework can be found elsewhere (Zhu and Kraemer 2005; Zhu et al. 2006b). Thus, the EDI adoption model of Iacovou et al. (1995) – rather than being recognized as an independent theoretical development, and rather than being acknowledged as having different drivers of the adoption process – is gradually becoming subsumed into the body of TOE research. This reality also prevents the theoretical evolution of the TOE framework. The TOE framework's elements of *technological context*, *organizational context*, and *environmental context* have not been contrasted with the EDI adoption model predictors of *perceived benefits*, *organizational readiness*, and *external pressure.*

Third and finally, other theories do exist in the area of adoption and DOI. The TOE framework is not the only option researchers have available to explain organizational adoption. Arguably the most similar explanation to TOE is DOI theory (Rogers 1995), with the aforementioned EDI adoption model of Iacovou et al. (1995), also somewhat related. Furthermore, network externalities have been put forward as an explanation for the adoption of certain types of innovations (Zhu et al. 2006a). Other theories of the adoption of innovations include task-technology fit theory (Cooper and Zmud 1990), institutional theory (Teo et al. 2003), the theory of organizational design (Swanson and Beath 1990), and social contagion theory (Angst et al. 2010). These theories can and have been utilized as alternatives to the TOE framework. These alternatives mean that the TOE framework need not be adapted or changed to apply in more varied contexts. Other theories exist that may fit the particular research context better.

A closely related point is that researchers have argued that perhaps it is not possible to have a single theory that applies to all types of innovations. Because innovations are of different types (Damanpour and Evan 1984; Robey 1986; Swanson 1994; Zmud 1982), it seems unlikely that a single theoretical explanation can be developed to describe the adoption and diffusion of all types of innovations (Kimberly and Evanisko 1981; Lai and Guynes 1997; Lee and Shim 2007; Thong 1999; Zhu et al. 2006b). While these arguments are well-founded, they have the potential to limit the comparison of theories with one another. By avoiding comparison and critique of the various theories of adoption of innovation, the refinement of these theories is restricted.

12.3.2 Future Directions for TOE Research

Future research with the TOE framework can take a number of directions. Perhaps the most obvious is that the TOE framework can continue to be used for empirical research. As long as new technologies are developed, and as long as novel contexts for adoption can be identified, the need to understand the adoption of innovation in organizations indicates that the TOE framework is capable of providing insights for researchers and practitioners. Thus, continued empirical work is one future direction for TOE research.

Other possibilities exist as well. For instance, one area of interest to researchers is interorganizational adoption. The TOE framework has been used to study the adoption of interorganizational systems, but only from the perspective of a single focal firm. Extant research does not examine how decisions are made when multiple firms must collectively reach a decision about a new system. How do the multiple firms' multiple technological contexts influence adoption? How do the multiple firms' multiple organizational contexts influence adoption? Is the environmental context viewed differently by different firms? Does the position of a firm in the value chain cause it to view new technologies differently than its value chain partners view those same technologies? Exploration and investigation of each of these questions would allow researchers to extend the TOE framework in ways that would increase its explanatory power or possibly reveal its limits. Such research would also provide actionable insights for practitioners in an age of increasing organizational interconnectedness.

Additionally, theoretical synthesis may extend and enrich the TOE framework. For instance, one explanation for the organizational adoption of many types of technology – an explanation that has slightly different emphases than the TOE framework – is that of network externalities. When the value of an innovation depends on the number of other users or other firms who adopt that innovation, positive adoption externalities, also known as network effects or *network externalities*, are said to exist (Katz and Shapiro 1985, 1986). Network effects can be either direct network effects, which are the physical effects of being able to exchange information, or indirect network effects, which arise from the interdependencies with other organizations in the use of complementary goods (Katz and Shapiro 1985, 1986; Weitzel et al. 2006). Numerous types of technologies are said to generate network effects, including computer networks for academic research (Gurbaxani 1990), EDI (Chwelos et al. 2001), and open-standard interorganizational systems (Au and Kauffman 2001; Riggins et al. 1994; Zhu et al. 2006a). In each case, the value of being a member of the network of adopters increases with each additional adoption decision. Thus, these researchers argue that network externalities are one of the primary reasons for adoption.

Where do network externalities fit within the TOE framework? Can they be understood as a characteristic of some specific types of technologies – and thus included as part of the technological context? Or are externalities something entirely different that the present TOE framework does not truly account for? It remains to be seen how the TOE framework will evolve and change in response to this theory.

Theoretical synthesis can take additional routes. Researchers have already included other theories and typologies in TOE-based research studies. Some researchers explain how the TOE factors predict use of an innovation, and then appeal to the resource-based view (RBV) of the firm to explain how use of an innovation creates value or improves performance (Mishra et al. 2007; Zhu and Kraemer 2005). Such research indicates that the dependent construct in the TOE model, technological innovation, might possibly be enlarged to include an element of organizational performance. Furthermore, TOE framework research has also included typologies of innovations such as Swanson's Type I, II, and III innovations (Chau and Tam 1997; Swanson 1994; Zhu et al. 2003; Zhu and Kraemer 2005; Zhu et al. 2004). If conditional statements could be made about how the technological, organizational, and environmental contexts influence the adoption of Type I, II, or III innovations, the TOE framework would be enlarged.

Yet another route for theoretical evolution involves exploring ways in which theories of individual behavior and individual adoption can influence the TOE framework's explanation of organizational adoption. Researchers have suggested that not only should the technological, organizational, and environmental contexts be considered, but also that task characteristics and individual factors should be included in studies of adoption (Premkumar 2003). In adoption research, some of the most widely used theories include the theory of planned behavior (TPB) (Ajzen 1985, 1991), the technology acceptance model (TAM) (Davis 1989; Davis et al. 1989), a more recent version of TAM known as TAM2 (Venkatesh and Davis 2000), and the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al. 2003). Perhaps a synthesis can be achieved that combines the strengths of these theories in explaining individual behavior with the strength of the TOE framework in explaining organizational behavior.

In sum, each of the ideas for future research listed above allows scholars to develop or critique the TOE framework and the research that supports it. Definitions of the three elements of a firm's context could be refined. Also, as noted above, the definition of the dependent construct could be perhaps enlarged. Furthermore, the ways that the TOE elements influence the various types of innovations could be discussed. And finally, theories of individual behavior can be examined for ways to enrich the TOE framework. The potential exists for much fruitful work to be done.

12.4 Conclusions

The adoption of innovations is clearly affected by the technological, organizational, and environmental contexts within a firm. Given this reality, it appears that the TOE framework will continue to provide useful guidance for researchers and practitioners. However, a variety of other ideas exist alongside the TOE framework. Competing theories will need to be addressed and the ideas within those theories will need to be incorporated into the TOE framework – or else critiqued by it. The challenge for researchers and theorists will be to comprehensively address these competing ideas and to craft a refined version of the TOE framework that is at the same time parsimonious and broadly applicable.

Fortunately, researchers know considerably more about the adoption of innovations than they did when the TOE framework was initially developed. The TOE model has been shown to be useful in the investigation of a wide range of innovations and contexts. Furthermore, it has been broadly supported in empirical work. It remains among the most prominent and widely utilized theories of organizational adoption since its development. The work of researchers in the coming decades will reveal how the TOE framework can continue to shape work on the adoption of innovations.

References

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Springer series in social psychology*. Berlin: Springer.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.

Angst, C. M., Agarwal, R., Sambamurthy, V., & Kelley, K. (2010). Social contagion and information technology diffusion: The adoption of electronic medical records in us hospitals. *Management Science, 56*(8), 1219–1241.

[AU3] Austin, R. D., Sole, D., & Cotteleer, M. (2003). Harley davidson motor company: Enterprise software selection. Harvard Business School Case Study, 9-600-006.

Burns, T., & Stalker, G. M. (1962). *The management of innovation*. Chicago: Quadrangle Books.

Chau, P. Y. K., & Tam, K. Y. (1997). Factors affecting the adoption of open systems: An exploratory study. *MIS Quarterly, 21*(1), 1–24.

Collins, P. D., Hage, J., & Hull, F. M. (1988). Organizational and technological predictors of change in automaticity. *Academy of Management Journal, 31*(3), 512–543.

Cooper, R. B., & Zmud, R. W. (1990). Information technology implementation research: A technological diffusion approach. *Management Science, 36*(2), 123–139.

Cyert, R. M., & March, J. G. (1963). *A behavioral theory of the firm*. Englewood Cliffs, NJ: Prentice-Hall.

Daft, R. L., & Becker, S. W. (1978). *The innovative organization: Innovation adoption in school organizations*. New York: Elsevier.

Damanpour, F., & Evan, W. M. (1984). Organizational innovation and performance: The problem of "organizational lag". *Administrative Science Quarterly, 29*(3), 392–409.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–339.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982–1003.

Ettlie, J. E., Bridges, W. P., & O'Keefe, R. D. (1984). Organization strategy and structural differences for radical versus incremental innovation. *Management Science, 30*(6), 682–695.

Galbraith, J. (1973). *Designing complex organizations*. Reading, MA: Addison-Wesley.

Globerman, S. (1975). Technological diffusion in the canadian tool and die industry. *The Review of Economics and Statistics, 57*(4), 428–434.

Grover, V. (1993). An empirically derived model for the adoption of customer-based interorganizational systems. *Decision Sciences, 24*(3), 603–640.

Iacovou, C. L., Benbasat, I., & Dexter, A. S. (1995). Electronic data interchange and small organizations: Adoption and impact of technology. *MIS Quarterly, 19*(4), 465–485.

Kamath, R. R., & Liker, J. K. (1994). A second look at japanese product development. *Harvard Business Review, 72*(6), 154–170.

Kamien, M., & Schwartz, N. (1982). *Market structure and innovation*. Cambridge: Cambridge University Press.

Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. *The American Economic Review, 75*(3), 424.

Katz, M. L., & Shapiro, C. (1986). Technology adoption in the presence of network externalities. *Journal of Political Economy, 94*(4), 822–841.

Kimberly, J. R. (1976). Organizational size and the structuralist perspective. *Administrative Science Quarterly, 21*, 571–579.

Kimberly, J. R., & Evanisko, M. J. (1981). Organizational innovation: The influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations. *Academy of Management Journal, 24*(4), 689–713.

Kuan, K. K. Y., & Chau, P. Y. K. (2001). A perception-based model for edi adoption in small businesses using a technology–organization–environment framework. *Information Management, 38*(8), 507–521.

Lai, V. S., & Guynes, J. L. (1997). An assessment of the influence of organizational characteristics on information technology adoption decision: A discriminative approach. *IEEE Transactions on Engineering Management, 44*(2), 146–157.

Lee, C.-P., & Shim, J. P. (2007). An exploratory study of radio frequency identification (RFID) adoption in the healthcare industry. *European Journal of Information Systems, 16*(6), 712–724.

Levin, S. G., Levin, S. L., & Meisel, J. B. (1987). A dynamic analysis of the adoption of a new technology: The case of optical scanners. *The Review of Economics and Statistics, 69*(1), 12–17.

Mansfield, E. (1968). *Industrial research and technological innovation*. New York: Norton.

Mansfield, E., Rapoport, J., Romeo, A., Villani, E., Wagner, S., & Husic, F. (1977). *The production and applicaiton of new industrial technology*. New York: Norton.

March, J. G., & Simon, H. A. (1958). *Organizations*. New York: Wiley.

Mishra, A. N., Konana, P., & Barua, A. (2007). Antecedents and consequences of internet use in procurement: An empirical investigation of us manufacturing firms. *Information Systems Research, 18*(1), 103–120.

Premkumar, G. (2003). A meta-analysis of research on information technology implementation in small business. *Journal of Organizational Computing and Electronic Commerce, 13*(2), 91–121.

Ramdani, B., Kawalek, P., & Lorenzo, O. (2009). Predicting SMEs adoption of enterprise systems. *Journal of Enterprise Information Management, 22*(2), 10–24.

Rees, J., Briggs, R., & Hicks, D. (1984). *New technology in the american machinery industry: Trends and implications, a study prepared for the use of the joint economic committee, congress of the united states*. Washington, DC: Government Printing Office.

Robey, D. (1986). *Designing organizations* (2nd ed.). Homewood, IL: Irwin.

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: The Free Press.

Scherer, F. M. (1980). *Industrial market structure and economic performance*. Chicago: Rand McNally College Publishing Company.

Swanson, E. B. (1994). Information systems innovation among organizations. *Management Science, 40*(9), 1069–1192.

Swanson, E. B., & Beath, C. (1990). Departmentalization in software development and maintenance. *Communications of the ACM, 33*(6), 658–667.

Teo, H. H., Wei, K. K., & Benbasat, I. (2003). Predicting intention to adopt interorganizational linkages: An institutional perspective. *MIS Quarterly, 27*(1), 19–49.

Thong, J. Y. L. (1999). An integrated model of information systems adoption in small businesses. *Journal of Management Information Systems, 15*(4), 187–214.

Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington, MA: Lexington Books.

Tornatzky, L. G., Eveland, J. D., Boylan, M. G., Hetzner, E. C., Johnson, D., & Roitman, D. (1983). *The process of technological innovation: Reviewing the literature*. Washington, DC: National Science Foundation, Productivity Improvement Research Section, Division of Industrial Science and Technological Innovation.

Tushman, M. L., & Anderson, P. (1986). Technological discontinuities and organizational environments. *Administrative Science Quarterly, 31*(3), 439–465.

Tushman, M., & Nadler, D. (1986). Organizing for innovation. *California Management Review, 28*(3), 74–94.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*, 186–204.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478.

Weitzel, T., Beimborn, D., & Konig, W. (2006). A unified economic model of standard difusion: The impact of standardization cost, network effects, and network topology. *MIS Quarterly, 30*(Special Issue), 489–514.

Zaltman, G., Duncan, R., & Holbeck, J. (1973). *Innovations and organizations*. New York: Wiley.

Zhu, K., & Kraemer, K. L. (2005). Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. *Information Systems Research, 16*(1), 61–84.

Zhu, K., Kraemer, K., & Xu, S. (2003). Electronic business adoption by european firms: A cross-country assessment of the facilitators and inhibitors. *European Journal of Information Systems, 12*(4), 251–268.

Zhu, K., Kraemer, K. L., Xu, S., & Dedrick, J. (2004). Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry. *Journal of Management Information Systems, 21*(1), 17–54.

Zhu, K., Kraemer, K. L., Gurbaxani, V., & Xu, S. X. (2006a). Migration to open-standard interorganizational systems: Network effects, switching costs, and path dependency. *MIS Quarterly, 30*, 515–539.

Zhu, K., Kraemer, K. L., & Xu, S. (2006b). The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business. *Management Science, 52*(10), 1557–1576.

Zmud, R. W. (1982). Diffusion of modern software practices: Influence of centralization and formalization. *Management Science, 28*(12), 1421–1431.