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Individual-Level Technology Adoption Research: An Assessment of the Strengths, Weaknesses, Threats, and Opportunities for Further Research Contributions

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Individual-Level Technology Adoption Research: An Assessment of the Strengths, Weaknesses, Threats, and Opportunities for Further Research Contributions

38.1 Introduction

Imagine the following conversation between two researchers at a research university located anywhere in the world:

Doctoral student/new researcher: “I’ve been reading about how and why people choose to use new technologies and am very interested in building on some of the recent technology adoption models.”

Doctoral advisor/senior researcher: “I don’t recommend it. There has been so much work done in that area that it is virtually impossible to demonstrate a contribution and get a paper on technology acceptance accepted at any top journal anymore. You would be much better off spending your time working on…”

Although the aforementioned dialog is imagined, the issue at the core of the conversation is not. How does a researcher interested in the broad phenomenon of individual-level technology adoption make a significant contribution? There can be little doubt that technology adoption has been one of the most dominant, if not the most dominant, streams of research in information systems research.
Using Information Systems and Technology to Support Individual and Group Tasks

(Benbasat and Barki 2007; Venkatesh et al. 2007), and papers from this stream of research are among the most cited in all of business and economics (ScienceWatch.com 2009). A quick examination of the titles and author-supplied keywords indicates that at least 7 of the 10 most highly cited papers in MIS Quarterly (MISQ) and 11 of the top 20 are related to individual “user acceptance” of information technologies (http://www.misq.org/skin/frontend/default/misq/pdf/MISQStats/MostCitedArticles.pdf). Moreover, the technology acceptance model (TAM), with Venkatesh et al. (2003) as the most influential paper in this stream, has been identified as one of the four fastest growing research fronts in business and economics (ScienceWatch.com 2009). Reflecting on our work in this stream, some of the most-cited papers in various journals are related to technology adoption: the two papers that originally introduced TAM—i.e., Davis (1989) and Davis et al. (1989)—are the most-cited papers in MIS Quarterly and Management Science, respectively; the paper that introduced unified theory of acceptance and use of technology (UTAUT)—i.e., Venkatesh et al. (2003)—is the second most-cited paper in MIS Quarterly; the paper that introduced TAM 2—i.e., Venkatesh and Davis (2000)—is the fifth most-cited paper in Management Science; papers that studied the antecedents of TAM constructs—i.e., Venkatesh and Davis (1996) and Venkatesh (2000)—are among the most-cited papers published in Decision Sciences (most cited) and Information Systems Research (second most cited), respectively. Thus, it seems clear that technology adoption is and is likely to remain an area of importance and interest to business researchers. If so, identifying answers to the question of how to identify and make a significant theoretical contribution to this very rich research stream is of vital importance to the academic community.

The maturity of individual-level technology adoption research has fueled much debate about whether this area of research is so mature that there are no more interesting and unanswered questions related to technology adoption left to be answered—this, in fact, is the central issue tackled in this chapter. This debate has revolved primarily around TAM (Davis et al. 1989). A special issue of the Journal of AIS in 2007 was dedicated to the discussion about TAM and related models (hereafter referred to as JAIS-TAM). The articles in the JAIS-TAM largely reflected the subjective reactions of several senior scholars to questions ranging from whether there is a future in TAM research to whether the model has even been good for the field at all. Criticisms of TAM range from its simplicity, to research simply replicating TAM in new contexts or making minor refinements to the model, to TAM hindering the development of more complex theories and detracting from the study of more relevant problems (see Bagozzi 2007; Benbasat and Barki 2007; see also Lee et al. 2003). In light of prior research explaining up to 70% of the variance in intention to use a system (Venkatesh et al. 2003), articles in the JAIS-TAM ranged from strongly hinting to explicitly stating that individual-level technology adoption research as we currently know it has almost no future.

Nonetheless, from a practical perspective, there is little doubt that technology adoption continues to be a significant business challenge as information system projects continue to fail at an alarmingly high rate (see Davis and Venkatesh 2004; Devadoss and Pan 2007; Morris and Venkatesh 2010). Despite apparent progress on the scientific front, if project success rates in practice have not improved, there are two possible explanations: (1) practice is disconnected from science—i.e., the message has not reached the practitioners or they have not applied the “lessons learned” from scientific research and/or (2) science is disconnected from practice—i.e., researchers have failed to provide meaningful actionable guidance (see Benbasat and Zmud 1999, 2003; Sambamurthy 2005; Straub and Ang 2008; Weber 2003). Our belief is that technology adoption research remains vital and is one important vehicle for addressing both of these broad gaps.

One of the sentiments conveyed in the JAIS-TAM is that although TAM and the associated body of research have been useful and served to integrate disparate bodies of research in the 1980s, it may have well outlived its useful life (Benbasat and Barki 2007). Benbasat and Barki (2007) further note that TAM is, at best, a middle range theory and, to advance scientific inquiry, it is important to move beyond TAM. Most of the other articles in the JAIS-TAM concurred with this basic idea and suggested that now, about 20 years after the publication of the original TAM papers, was an appropriate time to further our thinking about technology adoption research. We concur that significant progress has been made.
Individual-Level Technology Adoption Research

(see Venkatesh et al. 2007 for a review) and that more replications and minor extensions are not likely to be helpful in moving the boundaries of the domain forward. By definition, such approaches will only advance our knowledge in a very limited way. Thus, we agree with many scholars who have suggested (in the JAIS-TAM and elsewhere) that technology adoption research is stagnant in many ways, consistent with the normal science phase of a stream of research (Kuhn 1996; see also Silva 2007). In suggesting potential future research directions, the collection of papers in the JAIS-TAM presented some broad ideas about how one might make a theoretical contribution in this stream. Of course, each of the papers brought its own ideas (and biases) to the debate, and there was no attempt to group or coordinate the suggestions. The potential directions can be grouped into the following general categories:

1. **Determinants**: Benbasat and Barki (2007) point to the need to focus on determinants specifically tied to the IT artifact (i.e., system design characteristics). Similarly, Venkatesh et al. (2007) issued a call for additional determinants based on the fact that work in the reference disciplines has examined a broader set of determinants. Most of the work in this stream to date has primarily studied only technology characteristics and technology-related individual characteristics as determinants.

2. **Consequences/outcomes**: The various papers in the JAIS-TAM similarly called for richer theorizing around the outcomes and consequences of technology adoption and use (see Lucas et al. 2007; Venkatesh et al. 2007). Researchers have begun to probe this area more deeply (Barki et al. 2007; Burton-Jones and Straub 2006; Venkatesh et al. 2008); however, work in this area remains in its infancy.

3. **Alternative theoretical mechanisms**: Many have called for richer theorizing by examining alternative mechanisms that can better explain technology use. Bagozzi (2007) proposes a different theoretical perspective on technology adoption, grounded in much of his previous work. Citing Kuhn’s thoughts on scientific revolution, Benbasat and Barki (2007) have called for pushing the boundaries of our thinking with regard to theoretical explanations. They cite Wixom and Todd (2005) as an exemplar of such work. Lucas et al. (2007) call for research on multilevel models that can lead to a richer understanding of the phenomenon, and Schwarz and Chin (2007) call for a rethinking of the very meaning of acceptance—habit is used as an example of an alternative theoretical explanation (see Kim 2009; Kim et al. 2005; Polites and Karahanna 2012; Venkatesh et al. 2012). Venkatesh et al. (2007) note the scientific progress made in related reference discipline in examining alternative theoretical mechanisms and draw parallels to the work on technology adoption.

4. **Analytical issues**: Straub and Burton-Jones (2007) are most forceful in raising concerns related to common method bias, and others have recently echoed similar concerns about the research in this area (Sharma et al. 2009). Another example of a potential advance by leveraging more recent analytical techniques is presented by Lucas et al. (2007), who suggested the use of hierarchical linear modeling as a mechanism for providing new theorizing and analysis across levels that have largely been ignored in the work to date. Similarly, Kang et al. (2012) suggested multilevel analyses for the adoption of collaborative technologies as a fruitful step for additional work.

### 38.2 Strengths, Weaknesses, and Threats of Current Technology Adoption Research

As noted, although many authors have offered important and valid critiques of technology adoption research, it is first worth noting that the prior research has a number of important strengths. First and foremost, prior work has provided a mechanism for integrating disparate bodies of research. With its roots in social psychology, particularly the theory of reasoned action (TRA; Fishbein and Ajzen 1975) and the theory of planned behavior (TPB; Ajzen 1991), models of technology adoption tested in workplace settings have been used to explore individual use of technologies, ranging from personal productivity...
tools used in organizations (Davis et al. 1989) to electronic commerce applications (Duan et al. 2009), and everything in between. Clearly, the generality of the various technology adoption models has helped create a strong, cumulative tradition, with a rich set of empirical results. For example, a meta-analysis examining the role of voluntariness included a sample of 71 studies on technology acceptance (Wu and Lederer 2009). As indicated earlier, studies on technology adoption are among the most highly cited in all of business and economics and, thus, continue to exert a strong influence on research in various fields within business and economics.

Unfortunately, many of these strengths, when turned around, contribute to the stream’s most visible weaknesses. For example, although the extant literature provides a number of influential models of adoption capable of helping scholars understand a vast array of technologies, their generality precludes including any direct design guidance (Venkatesh et al. 2003). This criticism has been recurrent within this stream of research itself for quite some time (Benbasat and Barki 2007; Venkatesh and Davis 1996). Further, although the models are easy to apply, they are heavily reliant on perceptions as predictors of use rather than performance itself (Nielsen and Levy 1994; Venkatesh et al. 2003). Likewise, most technology adoption research starts and ends with the question on what drives technology use itself. This is an important and appropriate starting point for understanding the implementation of information systems in organizations. However, use (in and of itself) offers few advantages to organizations or managers; rather, the consequences of use are factors that are most relevant to researchers and managers interested in improving productivity and performance (see Burton-Jones and Straub 2006; Morris and Venkatesh 2010).

The series of identifiable strengths and weaknesses gives rise to a series of potential threats or concerns with the current state of technology adoption research. Kuhn (1996) argues that scientific thought in any given area proceeds from “prescience” (that lacks a central unifying paradigm), followed by “normal science” that is typified by a program of research on a phenomenon that is guided by foundational work acknowledged by the community as the basis for further investigation and practice. Kuhn (1996) charts the progress of dozens of scientific domains that follow a similar pattern of evolution. One of the main threats associated with this period of “normal science” is that it crowds out or suppresses inquiry that might lead to more revolutionary developments or a “paradigm shift.” Given the volume and impact of TAM and related follow-on models (e.g., TAM2, UTAUT, TAM3, UTAUT2), one can argue that by Kuhn’s criteria, the existing research on technology adoption provides an almost textbook example of a dominant theoretical paradigm that is in a period of “normal science” (see Silva 2007; Straub 2009a).

As opposed to a series of “one off” recommendations, one of our goals in providing a more organized, comprehensive framework in this chapter is to help structure future research in order to break out of the dominant theoretical paradigm and open new avenues of thought. In so doing, many researchers interested in this area of study might help create one or more revolutionary theoretical perspectives that lead to advances that might otherwise have been missed or ignored. A similar line of reasoning holds for the primary methodological techniques used in much prior work in this domain. Just as one can argue that there is a dominant theoretical paradigm in this stream, based on the methods, measures, and analytical techniques used in the vast majority of the influential papers in the stream, one can argue that there is a dominant methodological paradigm as well that results in a biased set of conclusions (Sharma et al. 2009; Straub and Burton-Jones 2007; Straub et al. 1995). Like a dominant theoretical paradigm, a dominant methodological paradigm can also have a stifling effect on creativity and scientific innovation.

We thus acknowledge and agree with many of our colleagues that demonstrating a meaningful contribution within the technology adoption and research stream can be a daunting task. The central question of this chapter is to determine what to do about it. On the one hand, the community can adopt a skeptical stance (as the fictional senior researcher in the opening paragraph) and back away from the challenge, essentially saying that the field has “been there, done that,” and it is time to move on to other important areas of research. Or, on the other hand, the community can look for ways to break free from the shackles of the existing dominant theoretical paradigm by supporting creative research that builds upon the legacy of work in what still appears to be an ongoing phenomenon.
Table 38.1 briefly summarizes the strengths, weaknesses, opportunities, and threats that we have outlined in the preceding analysis. In the sections that follow, we outline what we (and others) believe constitutes a theoretical contribution and offer our ideas for how to craft work that can make a strong contribution to this research stream.

### 38.3 Making a Contribution: Promising Future Research Directions

Before presenting a framework outlining future research directions, we first highlight some of the critical elements deemed essential for making a theoretical contribution drawn from the comments of Benbasat and Zmud (1999), Sutton and Staw (1995), Weber (2003), and Whetten (1989), among others. Many of the points made by these scholars have been reinforced in the editorial statements of the editors at *MIS Quarterly* (Saunders 2005; Straub 2009a; Weber 2003) and *Information Systems Research* (Sambamurthy 2005).

Weber (2003), in his editorial comments, stated that theory “is an *account* that is intended to explain or predict *phenomena* that we perceive in the world” (p. iv, emphasis in original). His articulation of the various ways in which theoretical contributions can be made is consistent with those described in Whetten’s (1989) influential remarks. Whetten (1989) noted and discussed four building blocks of theory development: *What* (constructs), *How* (relationships), *Why* (justification), and *Who, Where, When* (conditions). *Why* is likely the “…most fruitful, but also most difficult avenue for theory development” (Whetten 1989, p. 493). Weber’s (2003) commentary echoes this point by suggesting that theory should be able to account for phenomena. Also, he notes that the constructs and relationships serve as bases for building richer explanations for phenomena of interest. *Who, Where, and When* also possess potential if the conditions being examined are qualitatively different from prior research and/or if the nature of the relationships and outcomes are substantially different from prior research that helps understand the limits and boundaries of existing knowledge, thus furthering our understanding of the phenomenon at hand. As theorists have often noted, good theory is usually laced with a set of convincing and logically interconnected arguments. It can have implications that we might not be able to see with our
naked (or theoretically unassisted) eye. It may have implications that run counter to our commonsense. As Weick (1995) put it succinctly, “a good theory explains, predicts, and delights” (p. 378).

In Straub (2009a), the four required elements for a paper to be accepted at *MIS Quarterly* or other premier journals were identified to be (1) blue ocean ideas,* (2) research questions that are nontrivial, (3) popular themes, and (4) the use and development of theory. Both the notion of blue ocean and the importance of research questions ultimately boil down to contribution (Straub 2009a). As he goes on to note, “I believe that it is the unbeatable combination of a reasonably well applied theory answering interesting, novel questions in a well-known thematic stream of work that leads to blue oceans” (p. vii). In his example of nontrivial research questions, he notes that one of his papers (Gefen and Straub 1997) had a “simple enough” research question about how gender affected the causal relationships in TAM but given that the research question had not been studied before, the review team felt that the question was nontrivial. We leverage Straub’s (2009b) articulation of “blue ocean ideas” to propose our framework. Researchers can use the framework as a starting point to break out of the normal science phase that seems to currently typify technology adoption research (Kuhn 1996; Silva 2007; Straub 2009a).

The previously mentioned suggestions and guidelines for a theoretical contribution suggest four elements that are important motivators for future technology adoption research. After making a few observations about the relevance of each element for future technology adoption research, we then present a more comprehensive framework that can be used to motivate research that we believe has the potential to make a substantive contribution to the stream.

1. **Answer unanswered research questions related to important and interesting phenomena:** The pursuit of unanswered research questions should be considered by keeping in mind the need to focus on important and relevant business management phenomena (see Benbasat and Zmud 1999). Triviality of phenomena or findings is a fatal flaw for which papers should be rejected (see Saunders 2005; Zmud 1996). In other words, simply because a question has not been previously studied does not make it worthy of study. For example, even though it may not have been studied yet, research applying existing adoption models to the adoption of the next Windows operating system does not make it important or interesting. To this end, we concur with some of the ideas expressed by Benbasat and Barki (2007) by suggesting that one useful area within the technology adoption stream that has the potential to specifically address unanswered research questions—even within the context of existing models—is the exploration of determinants related to the IT artifact and theories that directly tap into properties of specific classes of technologies.

2. **Question/challenge prior theoretical perspectives and consider new theoretical perspectives:** Technology adoption research is dominated by research from the same paradigm of research (i.e., social psychology) from within which TAM was originally developed. We believe that questioning and challenging this dominant theoretical paradigm is essential to developing new theory and going beyond the boundaries of what is firmly established (see Sambamurthy 2005; Saunders 2005; Weber 2003; Zmud 1996). Thus, technology adoption research must leverage alternative theoretical perspectives to enrich our understanding, make progress, and provide innovative solutions to technology implementation and diffusion challenges. This can be achieved either by employing entirely new theories or by integrating previously unused theories in this context. Within technology adoption, examples of employing truly new theories include those offered by Kim and Kankanhalli (2009) using a *status quo* perspective and Malhotra et al. (2008) using organismic integration theory; unfortunately, although such examples exist, they are all too rare. Perhaps not surprisingly, there are a few more examples of integrating previously unused theories into the technology adoption context, including those by Sykes et al. (2009) for social networking, Devaraj et al. (2008) for personality, and Wixom and Todd (2005) for technology adoption and satisfaction.

* Drawing from marketing, Straub (2009b) describes blue ocean ideas to be those that are extremely innovative ideas that make competition irrelevant.
3. Relative to prior research, develop richer and more comprehensive explanations: A natural byproduct of questioning and challenging prior theory is that the process of thinking through such new theoretical perspectives and executing research that builds on new theory will almost certainly lead to richer and more comprehensive explanations of underlying phenomena (see Sambamurthy 2005). Although most new theoretical perspectives, as discussed earlier, can provide some insights into technology adoption processes, we believe there will be particular benefit and richness from spanning across levels of analysis. We must emphasize that we are not suggesting that technology adoption research should simply apply theories from other disciplines; rather, it should use/develop theories in ways that can help explain the unique elements of technology diffusion that will likely call for new constructs, relationships, explanations, and/or boundary conditions (see Herold et al. 2007; Johns 2006). Alvesson and Karreman (2007) note that examining general theories in specific contexts is essential to identify a theory’s boundary conditions in order to create the opportunity to extend existing theories. Identifying relevant boundary conditions and contingencies has been far too underrated in technology adoption research (see Weber 2003). We believe that a compelling demonstration of how relationships may change under new conditions—for example, gender as a moderator of key relationships (Venkatesh and Morris 2000; Venkatesh et al. 2000) or the implicit moderation of relationships when different types of systems were investigated (Van der Heijden 2004)—can represent an important contribution if they are anchored strongly in theory.

4. Expand the nomological network of relationships: In most prior research on technology adoption, the nomological network of relationships starts with technology perceptions (on the predictor side), and with few exceptions extends only as far as technology use (on the outcomes side). Building on the ideas of Sutton and Staw (1995), we suggest the need to study broader organizational and/or social phenomena where technology plays a role. We call for research to fully explicate and understand the determinants of technology-related constructs and behaviors and appreciate the impact of technology on outcomes that go beyond use as the primary dependent variable of interest. For example, it is surprising that little or no research on job satisfaction in organizational behavior or psychology has considered technology in any significant way despite the fact that technology has, without question, had a pervasive role in organizational life for well over two decades. A similar problem exists when examining research on technology acceptance and use at the individual level—researchers have simply not ventured far beyond technocentric constructs. Recent examples that guide us in this direction include Morris and Venkatesh (2010) who study job satisfaction and Raghunathan et al. (2008) who study stress. These exemplars illustrate why it behooves us to extend the reach and scope of our nomological networks (see Sambamurthy 2005) by bringing fresh new perspectives to the individual technology adoption phenomenon.

Against the backdrop of these four suggestions, we present a framework that we believe can help guide researchers interested in technology adoption topics (broadly construed) make a substantive contribution to the stream. For example, starting with a generic model of acceptance as the core layer in our framework, we have presented ideas for how researchers might begin to address unanswered questions and probe boundary conditions (points 1 and 4). From this starting point, we have constructed what we call “layers” that provide some specific suggestions and—more importantly—offer researchers a structure for finding ways to contribute meaningfully to the technology adoption literature. Working out from the core layer, our framework includes technology, individual, organizational, societal, and methodological/analytical layers. We believe that, as researchers explore ideas within and across the layers in the framework, it may help illuminate ideas that can be used to exploit potential new theoretical perspectives (point 2) and expand the nomological network of relationships (point 3) to new areas that have not been previously addressed or that are just starting to emerge in the literature.

Within the framework, we offer a number of specific suggestions that we believe have a high potential for making a contribution. This list is not exhaustive, but instead, it is meant to be illustrative of how
the framework might be applied. Implicit in the framework and building on the suggestions of other researchers is the notion that research agendas must be theory-driven. Simply because a construct or an idea appears in the framework does not, in and of itself, mean to imply that we believe all research on that focal construct or idea constitutes a contribution by definition. Rather, it means that we believe that research that focuses on that particular element or dimension of the framework has the potential to offer a contribution. In other words, it is incumbent upon researchers interested in studying the phenomenon to motivate their work based on the theory within the relevant dimension of the framework, not simply use the framework as the sole motivator for their work.

The first of the elements of the framework include technology adoption determinants (e.g., technology characteristics, individual characteristics, and job characteristics); technology adoption outcomes (e.g., job satisfaction, job performance); intra-individual alternative theoretical mechanisms (e.g., non-productive use or continuance); and extra-individual alternative theoretical mechanisms (e.g., teams, social networks, culture). In addition to theoretically driven research directions, the framework presents research directions that involve novel analytical techniques, such as polynomial modeling and agent-based modeling (ABM). Research that leverages new analytical techniques can span the theoretical ideas presented earlier and may, in fact, reveal new constructs or phenomena that were previously unaccounted. We hope that this framework can help scholars pursue important questions and, perhaps equally important, help reviewers and editors make fewer “type II” errors (see Straub 2008) when evaluating work in this stream.

Figure 38.1 and Table 38.2 present our framework and summarize our future research directions. We elaborate on this next.
### 38.3.1 Existing Models’ Layers

#### 38.3.1.1 Interventions

In order for research on technology adoption to have meaningful and maximal implications for system designers and managers, it is essential to design and test interventions that can be used in practice. Thus, looking at specific technology characteristics is a particularly promising avenue for future work. The interventions that can be studied range from specific design characteristics (Cyr et al. 2009; Lee et al. 2012; Lohse and Spiller 1999; Sun 2012) to training (Venkatesh 1999) to other types of managerial interventions (see Leonard-Barton and Deschamps 1988). The pervasive interest in the technology

### TABLE 38.2 Potential New Research Directions

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<th>Framework Layer</th>
<th>Concept</th>
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| 1. Existing models | Interventions | • Actionable design characteristics  
| Reconceptualizing constructs | | • Training mechanisms |
| | | • Nonproductive use |
| | | • Deep structure use |
| | | • Various technology adoption constructs |
| 2. Technological | New or complex technologies | • Enterprise systems |
| | | • Workflow management |
| | | • Decision aids/agents |
| 3. Individual | Individual characteristics | • Personality |
| | | • Other theoretically driven demographic or psychographic constructs |
| | Job characteristics | • Task significance, skill variety, task identity, autonomy, feedback |
| | | • Job demand, job control |
| | Job outcomes | • Job satisfaction |
| | | • Organizational commitment |
| | | • Turnover intention |
| | | • Job performance |
| 4. Organizational | Social networks and teams | • Size, shape, centrality, density |
| | | • Team variables (e.g., cohesion) |
| | Organizational units or levels | • Multilevel analysis of technology use |
| | | • Nonproductive use (team or org-level) |
| 5. Societal | Beyond organizations | • Environment |
| | | • Public policy |
| | | • Culture |
| | Beyond North America | • Culture |
| | | • Societal norms |
| | | • Questions of generalizability |
| | | • Questions of omitted variables |
| 6. Methodological and analytical | New methodologies and analytical techniques | • Curvilinear effects |
| | | • Polynomial modeling |
| | | • Common method bias |
| | | • Multilevel analysis (see organizational layer) |
| | | • Simulation |
| | | • Network analysis (see organizational layer) |

Note: These are illustrative areas that we see as important, but, of course, do not represent an exhaustive list of possible directions that could constitute a contribution.
artifact (see Benbasat and Weber 1996; Benbasat and Zmud 2003; King and Lytinen 2004; Orlikowski and Iacono 2001) certainly suggests that the design, development, theorizing, and evaluation of interventions, particularly tied to specific system design characteristics, are important. With respect to technology adoption in particular, Benbasat and Barki (2007) state that “…theorizing the effect of system characteristics on TAM variables is definitely harder” but go on to advocate this type of work as a valuable contribution to the discipline. In addition, the integration of technology adoption research with human–computer interaction research on usability is a noteworthy step in the direction of tying design interventions to known determinants of adoption (Agarwal and Venkatesh 2002; Palmer 2002; Zhang et al. 2002). It is important to note that we are not advocating a cycle of never-ending elaboration, incremental testing, and documentation of a range of outcomes associated with the use of various design characteristics, such as those specified by “design gurus” or best practices. Rather, we are calling for theory-driven examinations of design options or other interventions, grounded in research in software engineering, human–computer interaction, information visualization, and IS (among others). Such an exploration of key design interventions offers the potential for answering interesting questions, extending the nomological net of relationships, and providing a richer explanation for the adoption of new systems in ways that are practically relevant and keep the core properties of technologies as the appropriate focal point of study (Benbasat and Zmud 1999, 2003).

38.3.1.2 Reconceptualizing Constructs

For obvious reasons, technology adoption research has had a near-solitary focus on what could be termed “productive use.” Inherent in this work is one critical assumption: more use is better. This assumption implies that benefits derived from technologies will be maximized when the use of technologies is also maximized (Agarwal 2000; Devaraj and Kohli 2003; Venkatesh and Davis 2000). The broader implication of this assumption is that maximizing use always leads to more positive outcomes (in a linear fashion) and that there are no significant negative consequences associated with such use. In contrast, the trade press in the past decade or so has been rich with stories of several negative consequences of technology use, such as excessive Internet use, often leading to dysfunctional outcomes including decreased social involvement and increased depression (Kraut et al. 1998a; Young 2004). Although technology adoption research has long advocated use as a positive outcome that drives other positive outcomes, such as increased productivity at work and improved home life, psychologists have begun to focus on the potential negative consequences of excessive technology use. In addition to negative impact that technology can have on users in homes, technology use can result in loss of productivity due to employees using technologies to engage in nonwork-related tasks—e.g., chatting, browsing, and playing games—without being noticed. Interesting streams of research from psychology, sociology, and organizational behavior on addictions and withdrawal behaviors can be leveraged to help further our understanding of wasteful technology use, its determinants, its consequences, potential contingencies, and helpful interventions (see Tarafdar et al. 2010; Turel et al. 2011). However, this first calls for a fundamental rethinking of the use construct in order to broaden the scope of technology adoption research, paralleling the way the reach of technologies themselves has broadened.*

Burton-Jones and Straub (2006) challenged the traditional conceptualization of system use in favor of richer conceptualizations. Specifically, they proposed cognitive absorption and deep structure use as viable alternative dependent variables. They provided preliminary evidence that these conceptualizations of use were more strongly related to task performance. Burton-Jones and Gallivan (2007) and Barki et al. (2007) have also made suggestions about how to move forward with better conceptualizations of this key construct. Yet, much work remains to be done. What are the predictors of these conceptualizations of use? What are its consequences? How well do existing models of technology adoption

* Although beyond the immediate focus of this discussion, other areas that could be of interest along these lines include rethinking the conceptual foundations and role in the nomological network for various other constructs, such as service quality (see Wixom and Todd 2005).
predict these conceptualizations? What are the temporal dynamics and other contingencies involved in predicting these conceptualizations of use? These are but a few questions, that if pursued, would result in the emergence of the blue ocean ideas to which Straub (2009b) refers. We note that some recent work has started to examine different types of use and even its consequences (see Sykes and Venkatesh in press; Venkatesh et al. 2008), which we view as a positive step in helping open up new productive areas of research in the broad theoretical domain.

In addition to use, others have already made contributions to the stream by reconceptualizing other adoption-related constructs. Examples of this work include Schwarz and Chin (2007) who called for researchers to rethink the very idea of acceptance and Karahanna et al. (2006) who called for a reconceptualization of the compatibility construct. Likewise, Compeau et al. (2007) refined the conceptualization of perceived characteristics of innovations from Moore and Benbasat (1991). Taken together, this is an important and fruitful direction as it helps sharpen the definitions and measurements of constructs known to be important within the stream of research. Not only will this in turn result in better prediction of key outcomes, but it also offers the potential to provide greater richness and clarity in our explanations.

38.3.2 Technological Layer

Pushing beyond the inner layer of existing models in our framework, we believe that, at the technological layer, theorizing about newer, more complex types of systems is another fruitful avenue for new research. As an example, one type of system that researchers have successfully studied to date with a strong theoretical grounding is recommendation agents (see review in Xiao and Benbasat 2007). The collection of works examines various design characteristics that are unique to the context of recommendation agents and their impact on key evaluation criteria (Hevner et al. 2004; Komiak and Benbasat 2006; Wang and Benbasat 2005). Other such investigations have included collaborative systems (Brown et al. 2010), mobile data services (Hong and Tam 2006; Thong et al. 2011; Venkatesh et al. 2012), and protective ITs (Dinev and Hu 2007; Johnston and Warkentin 2010; Liang and Xu 2009).

Further expanding the idea of the need to look at specific technology characteristics, it is certainly true that one of the most significant changes in the last several years with respect to technology itself lies in the sheer complexity of modern technological systems. Interestingly, many of the technological systems studied in early technology adoption research were fairly simple, individual-level productivity tools. More recently, the implications for the use of more complex enterprise-wide systems that can span business units within the organization and even across organizational boundaries have been studied (Grewal et al. 2007; Karimi et al. 2009). Although researchers have begun to study the impacts of such systems, they are still typically conceptualized as a “black box” (Beaudry and Pinsonneault 2005; Morris and Venkatesh 2010), suggesting the need for more detailed theorizing around the nature of new technologies themselves. Clearly, these new systems have the potential to push the limits of our existing technology adoption theories. Although some elements of prior research findings may indeed hold in the context of complex systems—e.g., perceived usefulness will likely continue to be a driver of intention to use in these systems—it is also likely that complex systems will provide an opportunity for deeper theorizing about technologies, their implementation in organizations, and challenges associated with deploying such complex systems (see Boudreau and Robey 2005). As complex technologies will increase the interdependence among users both for information in the system and also for help using the system, they may increase the range of relevant independent and dependent variables of interest. This, in turn, will give rise to the need to use richer theoretical perspectives, such as social networks and multiple levels of analysis, which are discussed later in this chapter. Finally, complex technologies that integrate various business processes are in keeping with current phenomena and will extend the boundaries of existing models and may call for more sophisticated models (see Sambamurthy 2005; Weber 2003).
38.3.3 Individual Layer

38.3.3.1 Individual and Job Characteristics

Working outward in the framework to move beyond the existing models and technological layers, in organizational settings, it is clear that understanding the influence of both individual characteristics and job characteristics as technology adoption determinants also holds great promise (Morris and Venkatesh 2010). Specifically, moving beyond “technocentric” outcomes, such as use, expands the nomological network of relationships and creates a broader understanding of the implications of technology adoption. Such work is responsive to the suggestions of Delone and McLean (1992, 2003) who have specifically cited the importance of considering other metrics of system success, such as individual and organizational impacts. We extend their idea by suggesting that, within our framework, a similar case could be made on the predictor side as well.

Although research in psychology predicts many beliefs and behaviors using personality (Funder 2001), only limited technology adoption research has studied such constructs in much depth beyond technology-related personality traits, such as computer playfulness, computer self-efficacy, computer anxiety, and personal innovativeness with information technology (see Agarwal and Prasad 1998; Compeau and Higgins 1995a,b; Venkatesh 2000; Webster and Martocchio 1992). One notable and important exception is Devaraj et al. (2008). We believe that further work that studies the role of personality both as an antecedent and as a moderator could greatly enhance the predictive validity of existing models by helping organizations identify individuals with specific personality profiles that can help promote the use, success, and diffusion of technologies. Such work might include, but is not limited to, the big five (see Costa and McCrae 1992), locus of control (see Rotter 1954), and goal orientation (see Dweck 1986).

Just as personality would provide a better representation of the person, consideration of job characteristics can provide a greater understanding of the situational circumstances of employees. Surprisingly, few (if any) technology adoption studies have considered job characteristics or other job-related factors in predicting technology adoption decisions (see Venkatesh et al. 2003) as a means to advance our understanding. The job characteristics model (JCM; Hackman and Oldham 1976) and the demand–control model (Karasek 1979) offer useful ways to consider new theoretical perspectives that can be leveraged to study the impacts on technology adoption decisions (see Morris and Venkatesh 2010).

38.3.3.2 Job Outcomes

On the “downstream” side of the framework, outcomes, such as job satisfaction, organizational commitment, job performance—particularly objectively rated performance that avoids the common method variance concerns articulated in Straub and Burton-Jones (2007)—and other job outcomes that are of interest to employees and organizations should be integrated into technology adoption models to extend our understanding of the influence of use within the organization. Such research also has the potential to influence organizational behavior research by refining models of constructs like job satisfaction to encompass technology-related constructs as predictors that are especially important given the central role that technologies play in most jobs today (Herold et al. 2007). This would be particularly pertinent to organizational change interventions where both new business processes and new technologies are introduced concurrently as is often the case with technologies, such as enterprise resource planning systems (see discussion under the technological layer of the framework). In sum, we call for studies to help build a comprehensive nomological network of relationships that incorporate a richer, broader integration of upstream and downstream constructs that are related—yet distinct—from the traditional determinants and outcomes of technology adoption decisions.
38.3.4 Organizational Layer

38.3.4.1 Social Networks

Moving outward in the framework beyond internal, individualized theoretical layers to “extra-indi-
vidual factors” is a potential avenue for further exploration. Given that the space of theoretical
perspectives is vast, we provide one illustration of a promising avenue (among many possible avenues)—namely, social networks.* Traditional models of adoption and use have often (but not always) included a con-
struct meant to capture the impact of social factors. Sometimes called subjective norm or social in-
fluence, this construct captures the degree to which referent others influence an individual’s intention to
use (or not) the system in question (Taylor and Todd 1995; Venkatesh and Davis 2000; Venkatesh et al.
2003, 2012). However, despite its conceptual importance, the role of others in influencing individuals to
adopt new technologies has been inconsistent. Researchers have identified a series of moderating influ-
ences, such as gender, age, voluntariness, and experience (Venkatesh et al. 2003) that might clarify the
role that social influence plays. The next steps in this area should focus on examining the problem using
an extra-individual theoretical lens, such as that available via social networks theory.

Social networks have been used to explain a wide array of behaviors in organizations including early
promotion, career mobility, adaptability to change, and supervisor ratings of performance (Burt 1992;
Carroll and Teo 1996; Gargiulo and Benassi 2000; Podolny and Baron 1997). Further, within a more
technology-centric context, research on social networks has found that centrality in a workflow network
is positively associated with supervisor ratings in high-technology companies (Mehra et al. 2001). It also
has discovered that individuals are typically more reliant on individual relationships for finding new
information (e.g., about technologies) rather than organizational databases or other media including
Intranets or the Internet itself (see also Borgatti and Cross 2003; Davis et al. 2009).

Despite the positive individual (and by extension, organizational) performance benefits associated
with the appropriate leveraging of social networks, however, the role of social networks, including
their size, structure, and nature of the relational ties has not been fully leveraged within the technology
adoption research stream. One recent paper that offers a promising look at ways to incorporate social
network theory, method, and analysis is Sykes et al. (2009), where network constructs were shown to
explain significant additional variance in system use beyond the typical predictors studied in technol-
gy adoption research. Other forthcoming research leveraging social networks to better understand the
impacts of an implementation include Sykes et al. (in press) and Sykes and Venkatesh (in press).

We contend that social networks represent one theoretical paradigm that may be useful to under-
standing the role of others in influencing use in a general way as well as gaining a deeper understanding of
which others inside or outside the organization are the most important, and perhaps even why they
are important. Once again, we must note that we are not advocating a straight application of social net-
work theory and findings to technology adoption, but rather, we hope researchers will draw on it as a
new lens for developing a deeper understanding of behavior and as a mechanism for considering more
deeply the what, how, why, who, where, or when questions that remain relevant for technology adoption
and use in today’s organizations.

38.3.4.2 Organizational Units†

There are other potential avenues for productive technology adoption research that mandate theorizing
beyond the individual level of analysis. For example, Lucas et al. (2007) call for multilevel approaches

* Here, we use the term to refer to the scientific domain around social network theory, method, and analysis techniques—
this should not be confused with the emergent popular applications, such as Facebook. Applications such as Facebook
can and are used to develop and maintain social networks.
† The authors thank Dr. Likoebe Maruping for his advice on the integration of technology acceptance research with
research on teams.
that account for the influence of factors across different levels of analysis. Although there has been research at different levels, they have seldom been integrated. Individuals’ adoption and use of technology are often embedded in a social context and, thus, are open to influence by factors that are not currently accounted by an individual level of analysis (see Sarker and Valacich 2010; Sarker et al. 2005). As organizational researchers have noted, microphenomena in organizations and other social systems are embedded within macrocontexts (Kozlowski and Klein 2000). Hence, meso theories, which cross multiple levels of analysis, are necessary in order to advance our understanding of organizational phenomena (House et al. 1995). Unit-level factors (e.g., organizational, subdivision, functional, group) could and should be incorporated into models of technology adoption. For instance, within organizations, job types, skills, and the centrality or necessity of technology to the work differ across functional units. Multilevel models can capture the nature of these differences and how they affect individual adoption of organization-wide systems, whereas more sophisticated statistical techniques (which will be explicated in more detail in the methodological layer discussion) can be employed to help analyze such multilevel data (Bryk and Raudenbush 1992; Hofmann 1997).

Once again, to provide an illustrative example of how our framework might be applied in this context, one area that could benefit from a multilevel perspective on technology adoption is research on virtual teams. Much of the research on virtual teams has focused on how information and communication technologies (ICTs) support specific team processes (Dennis and Kinney 1998; Dennis et al. 2008; Nicholson et al. 2006; Powell et al. 2004; Sarker et al. 2005). Virtual teams need to be deliberate in their selection of technology to facilitate task completion (Maruping and Agarwal 2004); however, there is still a need to understand the processes through which the adoption of specific ICTs occurs. Maruping and Agarwal (2004) point to a need for future research to examine how individual differences (e.g., computer anxiety, remote work efficacy) affect virtual teams’ choice of ICTs. Reciprocal cross-level models, such as those suggested by Griffin (1997), could be used to model bottom-up processes fostered by individual differences as well to examine how the resulting team interactions influence individual intention to adopt a specific ICT. In sum, the development and testing of such models would provide a richer understanding of the dynamics affecting the adoption of technology in situations that extend beyond the scope of the individual.

### 38.3.5 Societal Layer

#### 38.3.5.1 Beyond Organizations

There has been a good bit of recent research on nonorganizational (e.g., household) use of technologies (Brown and Venkatesh 2005; Venkatesh and Brown 2001). Other focal areas of study for technologies typically used outside of the organizational context in recent years have been e-commerce (Pavlou 2003; Pavlou and Fygenson 2006; Pavlou et al. 2007) and m-commerce (Mathew et al. 2004; Sarker and Wells 2003; Venkatesh and Ramesh 2006) and other societal-level effects (Hsieh et al. 2008, 2010). The importance of extra-organizational use is only likely to increase in the coming decades. The emergence of social media (e.g., Facebook) makes our need to reexamine the application of existing theory and to consider new theoretical perspectives quite important (Gallaugher and Ransbotham 2010; Kane 2011; Kane et al. 2009).

#### 38.3.5.2 Beyond North America

Clearly, most contemporary technology adoption models have been developed, tested, and subsequently applied in North America. Despite new technologies reaching developing and even underdeveloped countries, our understanding of their adoption, use, and impact in these countries is remarkably limited. Although a few studies in IS have examined cultural differences, several practical and theoretical questions regarding the influence of culture on technology adoption and use remain unanswered (Karahanna et al. 2000, 2005; Straub et al. 2002). Culture, environment, and public policy are among
the factors that will almost surely play a significant role in adoption; yet, our understanding of their influence is limited. Importantly, there have been a few studies that have laid the groundwork for future investigations of culture and adoption (Bajwa et al. 2008; Cyr 2008; Gefen and Straub 1997; Sia et al. 2009; Srite and Karahanna 2006). In light of the spread and infusion of technology to new contexts, studies that further explore the boundary conditions around current models of adoption will be particularly useful. For example, some of the questions that are worthy of additional study may include: Is there cross-cultural generalizability for the models developed primarily in North America? Are there any omitted variables as we move the models to non-North American settings?

Complicating matters further, there are several specific methodological idiosyncrasies in cross-cultural research that are largely different from intracultural research that could potentially change the nature of results obtained in prior studies. For example, there is a high level of construct, method, and item nonequivalence across different cultures that raise questions about the generalizability of prior findings to new settings (see Johns 2006 for a detailed discussion about how different contexts, such as culture, can cause various changes to our theory and empirical findings). There are also several regional, ethnic, religious, and linguistic differences within each culture suggesting that examining culture as a phenomenon in its own right is required. As before, we would like to note that simply examining any question or model in a new cultural setting does not fit the bill of a substantive contribution. Rather, such investigations must start begin from a strong theoretical foundation, grounded in the unique and important psychological, environmental, or other social mechanisms relevant to the cultural context of study (see Venkatesh et al. 2010).

38.3.6 Methodological and Analytical Layer

38.3.6.1 New Method: Agent-Based Modeling

Despite the progress in technology adoption research, there are several puzzles and inconsistencies that remain that may be an artifact of the methodological approaches used in contemporary adoption research. Why do some technologies that would appear to an external observer to be useful and easy to use so often fail to garner the acceptance of target users (Markus and Keil 1994)? Why do some technologies lacking true usefulness so often become widely accepted (Davis and Kottemann 1995)? Why do some promising technologies gain initial adoption, only to fall by the wayside over time (Shapiro and Varian 1999)? More generally, why do technologies sometimes exhibit oscillating patterns of adoption (Maenrofer and Finholt 2002)? Technology adoption research to date has been unable to solve these puzzles.

To overcome these limitations, we propose the use of ABM methodologies that offer key complementary strengths (see Railsback and Grimm 2011) to the narrative, mathematical theories, and methods traditionally employed in technology adoption. Research on organizational adoption of innovations, such as total quality management (Repennig 2002), quality circles (Strang and Macy 2001), downsizing (Rosenkopf and Abrahamson 1999), and production technologies (Bullnheimer et al. 1998), have all found ABM valuable in providing insights into the dynamics of adoption beyond those afforded by more traditional methods (see also Latane 1996). A major reason for the insights is that ABM was used to incorporate both rational and social forces within a common modeling paradigm. Rational and social explanations have often been regarded as competing accounts for technology adoption (Kraut et al. 1998b; Schmitz and Fulk 1991). Even though neither is able to single-handedly explain technology discontinuance decisions, when combined, they can account for fad-like waves of adoption and rejection (Strang and Macy 2001). These initial applications of ABM to the study of organizational adoption illustrate how the complex interplay of various social influences give rise to unintuitive emergent global behavior across a population of firms. Similar advantages are expected to accrue through the use of ABM to specifically study individual-level adoption of technology. In a similar fashion, the dynamic complexity revealed by these organizational adoption studies portend that ABM can be used to solve
similar challenges in studying technology adoption at the individual and group layers of the framework.* ABM allows for simulations that have varying time granularity as well as detailed models of influence, thus allowing for a rich understanding of emergent phenomena that extends well beyond what exists in current models.

38.3.6.2 New Analytical Technique: Polynomial Modeling and Response Surface Analysis

In addition to new theoretical approaches and new methods, new analytical techniques might be utilized in order to bring new insights or perspectives to technology adoption and use. One approach—common in the management literature—that has not been employed to its full potential in technology adoption research is polynomial modeling and associated response surface modeling. Rather than being limited to the use of “best fit” linear models, the use of polynomial models allows researchers to capture more complex and dynamic behavior that, in the past, has been difficult to explore analytically. Although an in-depth discussion of polynomial modeling is beyond the scope of this chapter, the use of polynomial models and the related use of response surfaces can be used to plot two independent variables in relation to a dependent variable on a three-dimensional graph (see Edwards 1995; Edwards and Harrison 1993; Edwards and Parry 1993 for an extended discussion on polynomial models and response surface analysis). Such a technique is better able to capture the complex and nonlinear effects of change (e.g., the shift between pre-implementation and post-implementation attitudes) and avoids many of the methodological problems associated with difference scores that are often used such as weak reliability, conceptual ambiguity, and encapsulation of confounding effects of the independent variables on the components of the difference (Edwards 1995).

With respect to technology adoption and use, polynomial response surface modeling might be applied in a number of ways. First, although some have recognized the potentially important nature of changes in perception or use over time, most existing models have either attempted to control for prior perceptions (e.g., perceptions of usefulness at time 1 are used as a control on those at time 2), or have conceptualized the change as a single (new) construct meant to capture the dynamics of change. Either technique, although understandable given prior analytical constraints, reduces potentially nonlinear, multivariate relationships into a linear, univariate one, thereby suppressing a number of potentially interesting elements that may contribute to changing patterns of adoption and use over time.

Two examples of how polynomial response surface modeling might be applied to technology adoption and use may be helpful to illustrate its benefits. First, in studying some of the downstream consequences of use, one might examine how both pre-adoption and post-adoption perceptions combine in novel ways to influence user attitudes and/or performance. Such an approach would plot pre- and post-adoption measures on the X and Y axes, respectively, with the dependent variable of interest (say, performance) on the Z (vertical) axis. Another approach, consistent with the theoretical underpinnings of expectation–confirmation models, would be to measure pre-implementation expectations and post-implementation beliefs together (X and Y axes) to predict downstream perceptions or use (Z axis), rather than relying on a single construct, such as confirmation or disconfirmation, that typically had to be used in prior research to capture the differences (Bhattacherjee 2001; Bhattacherjee and Premkumar 2004). Venkatesh and Goyal (2010) and Titah and Barki (2009) are exemplars that use this approach to model nonlinear effects as a means to advance our understanding of technology adoption (see also Brown et al. 2012; Brown et al. in press). New work could build on these recent examples in order to identify opportunities for deeper theorizing about how shifts in constructs, rather than absolute levels themselves, might influence important outcomes such as performance or satisfaction, while simultaneously challenging the assumptions of linearity that underlie most current theorizing.

* Note that the methodological and analytical layer spans the other layers of the framework in Figure 38.1.

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38.3.6.3 Qualitative Research

We believe that qualitative research methods and associated approaches to interpret data hold particular promise for breaking the shackles of normal science in which technology adoption is currently situated. Qualitative research blends induction with search for novel insights that hypothetico-deductive approaches that have dominated this stream lack (see Locke 2007). Qualitative research has a rich tradition in business management research, with many well-known papers that present guidelines on how to do qualitative research (Benbasat et al. 1987; Lee 1989). Within the technology adoption stream, there have been some innovative papers that have brought to the fore new ideas, concepts, mechanisms, and even problems that were previously undiscovered (Sarker and Lee 2002, 2003, 2006; Sutanto et al. 2008; Wagner and Newell 2007). Taking the cue from these exemplars, we believe that the qualitative approach is underrepresented in technology adoption research and that researchers in the stream can further leverage these methodologies across each of the layers of our framework (Figure 38.1) to help identify new constructs, develop new theory, and create blue ocean ideas, consistent with the ideas of Straub (2009b). Further, the employment of multiple methods can lead to rich insights that any single method cannot provide (see Venkatesh et al. 2013).

38.4 Conclusions

In this chapter, we have made a case for the continued relevance and vitality of the technology adoption research stream. In so doing, we acknowledge many of the criticisms that have recently been levied at research in the area and agree with the broad conclusion that this important stream of research runs the danger of becoming stagnated unless we, as a community of researchers, can harness our creative talents to reinvigorate research in the domain. Although challenging, the problem remains critically important to research and practice, and we have a responsibility to conduct value-added studies that bring new scientific knowledge into the fold. Within the context of our critique and assessment of research on technology adoption, we have offered a new framework that we hope serves as a useful starting point for motivating additional work in the area that pushes all of us interested in the area out of our “comfort zone,” beyond “normal science,” and toward a period of research that pushes the boundaries of our existing knowledge through perhaps a scientific revolution that comes from breaking away from existing paradigms. In doing so, rather than declaring technology adoption research “dead” and having this chapter serve as its epitaph, we hope the thoughts and commentary here instead bring to mind the famous adages from such disparate personalities as Mark Twain and Steve Jobs indicating that accounts of one’s death—in this case, the technology adoption research stream—are greatly exaggerated. Indeed, we hope that our ideas here might serve a useful role in revitalizing one of the most mature streams in business management research. In doing so, we hope to bring an end to the debate on the merits of TAM and its derivatives per se and, instead, motivate proponents and critics of the current state of the research stream (and we count ourselves as both) to extend technology adoption theory to new frontiers of knowledge.

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