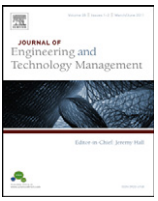
J. Eng. Technol. Manage. 29 (2012) 3–21

Contents lists available at SciVerse ScienceDirect

Journal of Engineering and Technology Management

journal homepage: www.elsevier.com/locate/jengtecman



Investigating the use of information technology in managing innovation: A case study from a university technology transfer office

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ARTICLE INFO

JEL classification:
O32 (primary)
O31 (secondary)
Keywords:
Innovation process management
Innovation applications
Technology acceptance

ABSTRACT

This study investigates the use of information technology to manage innovation. It is based on a case study on the adoption of an innovation application, which provides an interface between R&D, marketing and administration functions of innovation development. Drawing on qualitative evidence including a focus group and 16 in-depth interviews, this study contributes by integrating technology acceptance constructs to innovation process performance and marketing literature, as well as by investigating technology acceptance in an innovation context. Implications are discussed for organizations engaged with R&D or innovation process management and suggestions for research directions are offered.

Introduction

Innovation is becoming increasingly prominent in fostering competitiveness in operations and service management (Castellacci, 2009; Moller et al., 2008). Defined as 'the process of turning opportunity into new ideas and of putting these into widely used practice' (Lin and Ho, 2007, p. 3), innovation is important to assist firms in surviving adverse global financial conditions while also becoming instrumental for generating sustainable competitiveness (Wu and Lin, 2009). This is

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doi:10.1016/j.jengtecman.2011.09.002

evidenced by the race towards innovation and investment in green energy (e.g. solar energy and bioenergy), which is desirable for organizations to thrive into the future (Thavasi and Ramakrishna, 2009). Governments in many countries have identified innovation as a core element of their progressive policies. For instance, innovation forms an important element of President Obama's administration policy in the United States and it is also a significant component in policies and strategic research priorities of other countries, including the United Kingdom, Australia, India and China (Martin, 2009; Schläpfer, 2009; Smith, 2009; Tsai et al., 2009).

Given its growing prominence, the aim of this study is to investigate the use of information technology (IT) in managing innovation. While technology has been defined as a "capability, that is, physical structure or knowledge embodied in an artefact (software, hardware, or methodology), that aids in accomplishing some task" (Leonard-Barton, 1990, p. 45), viewing physical structure and knowledge as two separate forms, recent studies conceptualize knowledge as an inherent part of technology (Bozeman, 2000). Several technologies are used in operations and service science. Lin and Ho (2007) provide a useful classification incorporating data acquisition technologies, such as radio frequency identification systems (RFID); warehousing technologies, for instance automated storage and retrieval systems (AS/RS); transportation technologies, such as global positioning systems (GPS); and information technologies, including electronic data interchange (EDI) and point of sales (POS). Innovation applications fall within the group of information technologies involving networked systems (Kumar and van Dissel, 1996) that focus on knowledge management (KM) and collaboration (Cooper, 2003).

Bendoly et al. (2007) argue that the extant research focuses predominantly on tactical gains from technologies such as RFID and more research is needed to understand strategic gains as new technology emerges. This is particularly significant as innovation is increasingly becoming a strategic priority for contemporary management. Further research is necessary to enhance the understanding of the role technology can play in both operations and service management through the whole product life cycle from research and development (R&D) through the value chain to marketing and even disposal and reverse logistics. For instance, Chapman et al. (2003) argue that more attention should be placed on innovation in logistics.

This study focuses on yet another under-researched area, pertaining to the use of IT to strengthen one of the core aspects of the innovation process, namely, the strategic interface between R&D and marketing (Gupta et al., 1986; Song and Thieme, 2006). It is based on the setting of a university and its technology transfer office (TTO hereafter). This setting provides a unique opportunity to explore the use of an innovation application, an emerging information technology that supports the interface between R&D, marketing and administration by allowing researchers to enter project details at early stages of a research process, as well as by facilitating the communication and collaboration between R&D and marketing in the commercialization process.

Findings can offer valuable insights to a range of organizations. These include research organizations; government agencies, such as, grant administration bodies, cooperative research centers and industry linkage centers; businesses that engage in R&D, new product development and engineering and those that offer R&D consultancies and services; as well as universities and their TTOs that are involved in improving industry research partnerships. This study examines the perceived benefits of an innovation application, thereby providing valuable insights to managers aiming to foster buy-in and adoption in their organizations. It also explores perceived adoption barriers, an understanding of which can help in both eliminating underlying causes or at least in reducing potentially adverse impacts.

In investigating the use of technology in innovation management, we apply technology adoption literature (Cheng et al., 2006) and relevant marketing literature related to brand attitude (Keller, 1993; Li et al., 2002; Lowry et al., 2008; Yeung and Wyer, 2005) to the innovation management literature. While some authors have initiated the link between technology use and marketing concepts, such as customer retention, commitment and trust (Li et al., 2006), opportunities for a more integrated understanding are yet to be realized. By integrating these literatures, this study makes several contributions. First, technology acceptance, henceforth referred to as TA, constructs are linked to outcomes in response to a call for research in this area by Goodhue and Thompson (1995). Second, the paper includes relevant marketing literature following calls to tie TA constructs to other mature

streams of research (Venkatesh et al., 2003). Third, it examines TA constructs in an innovation development and commercialization context. Extant literature has examined TA and use in the contexts of supply chain management, customer relationship management, enterprise resource planning systems and even in other general stand alone application settings rather than in innovation contexts (Cooper, 2003).

The structure of the paper is as follows. First, the literature review provides a discussion of TA and related literatures, leading to a theoretical framework for the adoption of innovation applications. To confirm the validity of the conceptual framework, the method, a case study involving a focus group and in-depth interviews, is outlined next. Findings are then presented illustrating and validating the proposed framework by means of the case data. Managerial implications are highlighted for organizations engaged with R&D or innovation process management so that they can become aware of perceived benefits and barriers to adopting innovation applications for enhancing the effectiveness of launch and roll-out efforts. A discussion of limitations and future research directions concludes the paper.

Literature review

Technology acceptance

The TA literature can be applied to aid our understanding concerning the use of technology in managing innovation. Specifically, the TA model (TAM) has been developed in an attempt to explain system use by individuals in work settings (Davis, 1989; Davis et al., 1989, 1992). It is based on two constructs, namely, perceived ease of use and perceived usefulness. TAM has been found to be instrumental in explaining and individual's intentions of using a system, as technology that is easy to use and useful will lead to a positive attitude and, in turn, intention towards using it. With these constructs, TAM is considered by many to be the most robust, parsimonious and influential model in explaining technology adoption behavior (Chau, 1996; Elliot and Loebbecke, 2000; Venkatesh et al., 2003). The prediction power of the TAM constructs has been empirically supported extensively through validations, applications, replications, and even extensions for various technologies (Agarwal and Prasad, 1998; Chau, 1996; Chau and Hu, 2001; Horton et al., 2001; Taylor and Todd, 1995a,b; Venkatesh and Morris, 2000). While TA constructs have been applied in predominantly operational contexts, they have not been applied to the realm of innovation, which is becoming increasingly pertinent (Cooper, 2003; Damanpour and Wischnevsky, 2006; Dong et al., 2008).

Technology acceptance constructs

The TA literature entails a number of constructs, most prominently, perceived usefulness of the technology and perceived ease of use, which impact on the attitude towards the technology, which, in turn, determines the intention to use the technology. First, perceived usefulness is "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320). As such, potential adopters assess the consequences of their technology adoption behavior based on the ongoing usefulness derived from the innovation (Chau, 1996; Venkatesh and Davis, 2000). In fact, TA research suggests that a technology "that does not help people perform their jobs is not likely to be received favorably" (Nysveen et al., 2005, p. 537). Perceived usefulness is also known as performance expectancy (Venkatesh et al., 2003), which is based on the expectancy theory that models the roles of beliefs in decision making (Porter and Lawler, 1968; Robey, 1979; Vroom, 1964). A technology is seen to be of high usefulness when a potential adopter believes that there is a direct relationship between use, on the one hand, and productivity, performance, effectiveness or satisfaction, on the other (Lu et al., 2003).

Although a technology might provide at least some degree of usefulness, a potential reason not to adopt exists when adopters fail to see the "need" to adopt (Zeithaml and Gilly, 1987). Adopters may not be able to recognize their needs until they become aware of the supporting technology or its consequences (Rogers, 1995). Need recognition is, therefore, likely to drive potential adopters to educate themselves in order to be able to utilize a technology fully before being able to recognize its

usefulness. This, in turn, is likely to enhance the rate of adoption (Rogers, 1995; Saaksjarvi, 2003). The recognition of usefulness is important because it has been found to have a strong direct effect on the intention of adopters to use a technology (Adams et al., 1992; Davis, 1989). Furthermore, extant research has found perceived usefulness of a technology to significantly influence attitude towards using that technology (Chau and Hu, 2001; Chen et al., 2002; Chen and Tan, 2004; Gefen and Straub, 2000; Kaufaris, 2002; Lederer et al., 2000; Lee et al., 2006).

Second, perceived ease of use has been defined as the "degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). Other constructs that capture the notion of perceived ease of use are complexity and effort expectancy (Rogers, 1995; Venkatesh et al., 2003). Perceived ease of use may contribute towards performance, and therefore, perceived usefulness and lack of it can cause frustration, in turn, impairing the intention to adopt a technology (Davis, 1989; Taylor and Todd, 1995b; Venkatesh, 1999; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000). Nevertheless, "no amount of EOU [ease of use] will compensate for low usefulness" (Keil et al., 1995, p. 89).

The impact of perceived ease of use on a user's intention to adopt technologies either directly or indirectly through perceived usefulness has been well documented in the literature. However, its role remains controversial (Fang et al., 2005). In fact, Fang et al. (2005) found that the nature of technology or innovation or task or service related to it may influence its perceived ease of use. For example, perceived ease of use affects the intended use of a particular technology only when it provides intrinsic motivation but not when it provides extrinsic rewards to its users (Gefen and Straub, 2000). In addition, user-friendly and usable intuitive man-machine interfaces, including clear and visible steps, suitable content and graphical layouts, help functions, clear commands, symbols and meaningful error messages are likely to influence perceived ease of use (Condos et al., 2002; Lederer et al., 2000). Extant research shows that attitude towards using a technology is directly affected by perceptions held by users concerning its ease of use (Chen et al., 2002; Chen and Tan, 2004; Gefen and Straub, 2000; Kaufaris, 2002; Lederer et al., 2000; Lee et al., 2006). Additionally, perceived ease of use can also directly affect individuals' intention to use a technology (Chau, 1996; Davis, 1989; Karahanna et al., 1999; Venkatesh, 1999, 2000; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000).

Third, the users' attitude towards technology refers to their "positive or negative feelings (evaluative affect) about performing the target behavior" (Fishbein and Ajzen, 1975, p. 216). Attitude is a complex multidimensional construct that comprises affective, cognitive, and conative information components concerning a behavior (Crites et al., 1994; Zhang et al., 2008). In TA research, attitude has been defined as an evaluative summary judgment or predisposition to respond either favorably or unfavorably to a computer system and software, staff, or procedures related to it (Hong et al., 2008; Melone, 1990). There is evidence to suggest that there is a direct relationship between attitude towards using a technology and the user's behavioral intention to continue to use it (Fishbein and Ajzen, 1975; Karahanna et al., 1999; Kim et al., 2008; Nysveen et al., 2005).

The consideration of attitude in TA models is debatable, as empirical studies have found inconclusive and inconsistent results concerning the role of attitude on the intention to use technology (Zhang et al., 2008). For example, attitude was removed from earlier TA models on the grounds that it did not appear to fully mediate the effect of perceptions of usefulness and ease of use on behavioral intention (Venkatesh and Davis, 1996). It was theorized not to be a determinant of intention to use technology and, consequently, excluded from original TA models (Davis, 1989; Lee et al., 2006). On the other hand, a supporting argument was that original versions of TA models were applied in work settings where users were expected to use technology irrespective of their attitudes or affective evaluations towards it (Chau, 1996; Chau and Hu, 2001; Venkatesh, 1999; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000; Venkatesh et al., 2003).

Nevertheless, attitude constitutes an important notion in social psychology studies because it "play[s] important roles in people's judgments, evaluations, and behaviors." (Zhang et al., 2008, p. 629). Because TA and use are social phenomena, attitude should also play an important role in technology adoption contexts. Additionally, attitude is important in work contexts where users have experiences with similar or earlier versions of the target technology. Arguably, in work settings users would rarely use completely new technologies (Zhang et al., 2008). Additionally, there appears to be relative autonomy and control amongst some of the users of innovation applications. This suggests

that even in work settings where partners from different organizations collaborate in innovation projects, usage of technology can be voluntary or optional. However, in voluntary conditions TA or usage is only likely to ensue when users hold favorable attitudes towards it, but unlikely if users have unfavorable attitudes (Liker and Sindi, 1997). Taken together, these arguments suggest that attitude needs to be included as an antecedent to intention to use a technology, a notion confirmed repeatedly in the literature (Agarwal and Karahanna, 2000; Galletta et al., 2004; Venkatesh et al., 2003).

Finally, measuring the extent to which users become engaged in using a technology may not always be practical in research. While initial intention to use the technology is critical to its eventual success (Davis et al., 1989; Stone et al., 2007), extant research has demonstrated that a strong casual relationship exists between the intention to use a technology and the actual targeted behavior of using it (Sheppard et al., 1988; Venkatesh and Morris, 2000). This suggests that the former can be used as a surrogate for the latter (Kim et al., 2008; Mathieson, 1991). In fact, usage intentions are more appropriate than actual usage as "they are measured contemporaneously with beliefs" (Agarwal and Prasad, 1998, p. 367). Usage of the innovation application was still at its early stages at the time that this study was carried out and its widespread adoption in innovation clusters was yet to occur. Therefore, employing intention to use as a surrogate for actual behavior is desirable, adequate and realistic, thereby enabling the investigation of the adoption of the innovation application at the time when an increasing number of organizations are expected to adopt it (Chau and Hu, 2001). In summary, perceptions concerning technology ease of use and usefulness are expected to impact users' attitudes towards it. Attitudes, in turn, affect intention to use technology (Stone et al., 2007).

Theoretical model for adoption of innovation applications

The role of innovation in organizations and complete economic systems is well documented (Moller et al., 2008; Wu and Lin, 2009), and has lead to the establishment of prolific research streams in the areas of innovation, new product development and research commercialization (Adnan et al., 2004; Gupta et al., 2000; Chapman and Hyland, 2000; Buenstorf, 2009; Francis and Bessant, 2005). The use of technology is of growing interest to researchers in the innovation management field (Chiesa et al., 2008; Ferrante, 2006; Ragatz et al., 1997). Therefore, investigating the applicability of core elements of the TA literature would be useful. However, research relating to the use of IT in managing innovation remains sparse, with an exception of researchers such as Cooper (2003), who provide an outline of the practitioner experience with existing tools used in new product development processes.

We extend the original model with additional suitable constructs, aiming to create a comprehensive model concerning the use of technology in the innovation management context. In investigating innovation applications, two main concepts are thus introduced next, including the attitude towards the brand and innovation process performance.

Attitude towards brand

Branding is a cornerstone of marketing theory and practice, and prominent research streams have been developed around topics such as brand equity and brand extensions (Czellar, 2003; Harris and de Chernatony, 2001; Raggio and Leone, 2007). Brands provide firms with the opportunity to differentiate themselves from competitors and to establish bonds with customers based on familiarity and trust (Wood, 2000). Attitude towards a brand constitutes positive or negative perceptions accumulated in a person's memory concerning a particular brand (Keller, 1993; Lin, 2008). As cognitive science has demonstrated that memory is durable, it follows that perceptions concerning brands can also be highly enduring (Lowry et al., 2008). Brand perceptions can represent three different aspects. Product perceptions embody functional benefits; appearance perceptions embody the visible and tangible including look-and-feel, trademark, casing and packaging; and communication perceptions emphasize impact of TV, Internet and newspaper advertising (Qi et al., 2009). Moreover, the use or non-use of brands by individuals and groups affect brand perceptions, so that brands "reflect the complete experience that customers have with products" (Keller and Lehmann, 2006, p. 740).

Of particular interest in the area of innovation and technology marketing remains the drivers of successful brand extensions (Czellar, 2003). Utilizing an existing brand to introduce new products or services to the market allows an organization to limit risks related to market introductions given

existing brand familiarity, while reducing distribution-related costs (Aaker and Day, 1990). Such transfer of affect has been confirmed empirically for situations in which the parent and the extension products were perceived as similar or fitting in relation to product categories (Buil et al., 2009; Bottomley and Doyle, 1996; Park et al., 1991) and where the extension makes sense to consumers (Keller and Lehmann, 2006). However, risks can entail a negative impact on the parent brand, should the extension be ill perceived (Aaker and Day, 1990). These considerations are also relevant when evaluating the use of a new technology within an existing brand concept.

The brand of an organization, a product in general or a technology in particular can trigger affective reactions (Yeung and Wyer, 2005). Consequently, users that are exposed to a particular brand may use the perceptions it elicits as an indication of their feelings towards both this brand and other products or technologies associated with it (Schwartz and Clore, 1996; Wyer et al., 1999; Yeung and Wyer, 2005). For example, the attitude that an individual holds towards a financial services provider shapes that person's perceptions about new or revised products or services, such as online banking, provided under the same brand name. It should be noted, however, that responses to brand extensions may also be influenced by factors such as the perceived quality of the original brand (Bottomley and Doyle, 1996) and ownership of the parent brand (Kirmani et al., 1999), likely to trigger more positive evaluations of extensions.

Transfer of brand perceptions from the parent brand to the extension is particularly meaningful during the early introduction phase of brand extensions. Given the lack of familiarity with the extension, consumers utilize their existing associations with the parent brand to form an opinion about associated products and services (Bhat and Reddy, 2001). Research in the domain of mobile technologies has provided insight in a technology context, suggesting that previous experience with a brand, conceptualized as similar to brand attitude, can affect the consumer's attitude towards using associated technologies (Qi et al., 2009). While providing an indication of the applicability of brand extension research to the extension of TAM, further research is required. In particular, this study furthers the introduction of brand theory to technology adoption literature by examining a particular extension of a brand and the attitudes towards that extension, rather than considering attitudes towards services in general, as conducted by Qi et al. (2009).

Perceived impact on innovation process performance

Due to increasingly greater expenditures and reliance on technology, there is a stronger drive to assess factors that affect perceptions of technology success and its impact on performance (Ishman et al., 2001; Ryan et al., 2002). The manner and the extent to which adoption factors influence performance perceptions remains under-explored (Stone et al., 2007), although seminal evidence concerning this can be found in Goodhue and Thompson (1995). The inclusion of perceived impact on innovation process performance as a surrogate outcome measure goes beyond technology adoption. Lin and Ho (2007) have included supply chain performance as the outcome variable for technology adoption by organizations; however, their study was based on a supply chain context rather than one pertaining to innovation. Furthermore, it was focused on the organizational rather than individual adoption and it did not incorporate TAM. Therefore, research is needed which extends TAM to include performance (Goodhue and Thompson, 1995).

McAdam et al. (2005) argue that given the network approach involved in innovation compared to the linear approach predominantly employed in traditional process management, there is paucity of research concerning performance outcomes that can result from managing innovation processes. However, performance outcomes can vary across domains or environmental conditions, such as engineering, accounting and marketing (DeLone and McLean, 2003). For example, Stone et al. (2007) argue that depending on the task being performed, accountants and plant managers use technology to accomplish different performance outcomes. In another study focusing on marketing, Stone and Good (2001) utilize strategic and tactical marketing activities as dependent variables. More generally, depending on the domain, performance outcomes can differ and range from the ability to achieve competitive advantage, to increased productivity, to efficiently manage inventories, customer relationship management, scheduling personnel shifts, to service quality, etc. Thus, while the use of technology should affect the perceived impact on performance, it remains to be tested in the innovation domain (Rogers et al., 1996; Stone et al., 2007) and is attempted in this paper.

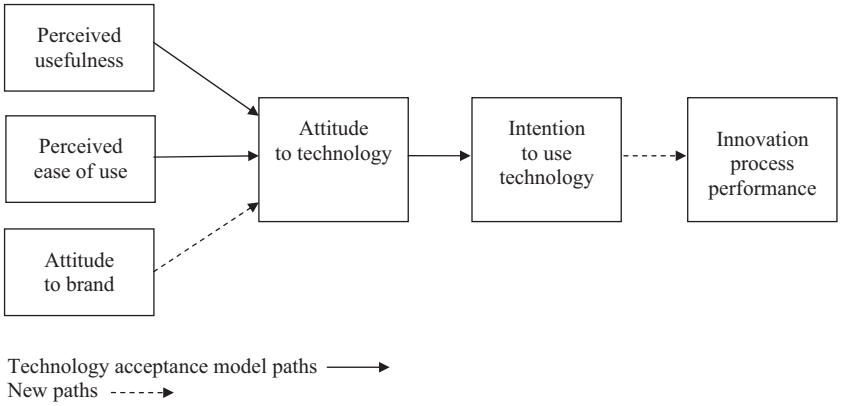

Fig. 1. Conceptual framework for the adoption of information technology for innovation management.

Conceptual framework

Based on an in-depth literature review, which aimed at integrating TAM with other relevant streams of literature in an innovation management context, a conceptual framework can be derived, as shown in Fig. 1. As outlined in the following section, qualitative research was undertaken to validate and illustrate this framework.

Research design

The adoption of innovation applications is still in its infancy in Australia. Their development and diffusion can, therefore, be better understood by examining the interpretations of relevant stakeholders (Van de Ven and Rogers, 1988; Wolfe, 1994). The research reported in this study is exploratory and utilizes qualitative evidence. A qualitative exploratory approach enables the study of dynamic, intricate, and multifaceted processes and the exploration of emerging themes (Cassell and Symon, 1994; Smith and Fischbacher, 2005). We chose a case study to achieve our aim.

A case study is an empirical inquiry that attempts to investigate a problem in its real-life context. Typically, in a case study, the boundaries of the problem are not always clearly evident (Gable, 1992). To minimize the impact of this and to collect supporting data, we used both a focus group and interviews (Galliers, 1990, 1993; Marshall and Rossman, 1989). The main advantage of the case study is that it allows "the capture of 'reality' in considerably greater detail (and the analysis of a considerably greater number of variables)" (Galliers, 1990, p. 162). To identify the site of the case study, we followed Marshall and Rossman (1989). Accordingly, the selected site is "ideal" as "(i) entry is possible; (ii) there is a high probability that a rich mix of many of the processes, people, programs, interactions and/or structures that may be part of the research question will be present; (iii) the researcher can devise an appropriate role to maintain continuity of presence for as long as necessary; and (iv) data quality and credibility of the study are reasonably assured by avoiding poor sampling decisions" (Marshall and Rossman, 1989, p. 54).

In this case study qualitative empirical data were collected in two stages. During the first stage, which took place in April 2009, a focus group comprising six experienced participants from university was used. This was useful for exploring and pre-testing general ideas, as well as for stimulating the creative process and generating relevant content areas and themes (Kinnear et al., 1996; Zikmund, 2003). In a single 80-min meeting with this focus group, the interviewers established further familiarity with the topic by using semi-structured questions for exploring innovation development and commercialization experiences, roles, and outcomes before and after the introduction of the innovation application. This was advantageous as the focus group was relatively inexpensive to conduct but it produced rich cumulative and elaborative data while also helping with "indefinite triangulation" by putting responses from individual participants into context (Fontana and Frey,

2000). The discussion amongst focus group participants was free-flowing and flexible (Ticehurst and Veal, 2000), which increased the likelihood of new topics emerging (Kinnear et al., 1996; Zikmund, 2003).

The second stage included sixteen in-depth face-to-face interviews, which were conducted between June and July 2009 and ranged from 30 to 75 min. In-depth interviews were used because of their flexibility and ability to provide rich insights for exploring, identifying and understanding viewpoints, attitudes, and influences (Healy and Perry, 2000) and were seen as particularly valuable if the expected information is likely to vary considerably (Ticehurst and Veal, 2000). Moreover, they also allow control over the interview situation (e.g. sequencing of questions) while providing opportunities for making clarifications and collecting supplementary information (Frankfort-Nachmias and Nachmias, 1996; Walsham, 1995). Specifically, in this study the interviews allowed the interviewers to hone in further into the exploration and examination of issues and themes that were raised in the focus group concerning drivers, barriers, and benefits of adopting the innovation application.

The case organization and the innovation application

The case organization is a mid-sized university in Australia and its TTO, which developed an innovation application aimed at assisting individuals and groups in dealing with the development and commercialization of ideas and innovations. The context of a university was seen as valuable for this study, given the relevance of such institutions within national innovation systems (Arnold et al., 1998). Although fully owned by the university, the TTO operates as a separate organization, with an independent management team and board of directors. The innovation application, the adoption of which is being investigated in this study, was developed in-house at the TTO. It provides a web-based platform for analyzing research projects, assessing market readiness and advising on requirements before ideas or research outcomes can be commercialized. While such services have been offered by TTO staff previously, the application provides an online tool and an engagement and evaluation platform for researchers, the TTO, university management and other internal stakeholders, providing additional support for all parties in creating value from research. Hence, the application was deemed to extend and support existing services rather than offer a completely new service. The inclusion of the parent brand name, in the name of the innovation application further clarified and strengthened the connection between the parent brand and the brand extension, that is, the TTO brand and its extension in the innovation application.

While the innovation application allows the storage of contracts or any other documentation relevant to innovations being developed and commercialized, its primary aim is to cover the process leading up to the storage of information on intellectual property (IP) and relevant transactions supporting the detection of relevant projects, the identification of issues that need to be solved prior to successful commercialization, while providing a common interface for all relevant parties in the process. For example, researchers who have innovative ideas that might be commercially relevant can log onto the application and complete a questionnaire related to the general market, IP, and other relevant areas. The application then transforms the given answers into issues that need to be solved, as well as work plans showing all relevant actions that need to be undertaken for moving successfully from idea to realization and subsequent commercialization. The innovation application may also be used as a project management tool, e.g. for consulting or contract R&D projects.

Sampling

While judgment sampling was used for this study, it should be noted that the sample covers a large number of staff who had been introduced to the innovation application at the time of data collection. Despite the early stage of its adoption, a variety of interviewees were available, with six researchers and research administrators attending the inductive focus group (i.e. first stage), followed by 16 in-depth interviews (i.e. second stage). All key informants were considered knowledgeable within their organization on the topics of interest.

In principle, two groups of interviewees can be differentiated, namely, researchers and research administrators at the university and those employed by the TTO. The seven interviewees employed by

the university included four researchers (Interviewees_researchers#1–4) and three research administrators (Interviewees_administrators#5–7), active in various research contexts and faculties, including health sciences, chemistry, physical and earth sciences, computer sciences, business, social sciences and environmental sciences. While the researchers were involved in carrying out the research, sourcing funding and building collaborative relationships, research administrators played a crucial role in facilitating the commercialization process by assisting with the writing of grant applications, undertaking accounting tasks or in lodging patent applications. Hence, while their tasks to some extent overlap with those undertaken by the TTO, the role context is different. Furthermore, while TTO staff is expected to use the innovation application, it is offered on a voluntary basis to both research administrators and researchers at the university.

Nine interviews were conducted with staff at the TTO (Interviewees_TTO#8-16), all of whom have used the application to the full extent as is relevant to their individual roles. Amongst the nine TTO interviewees, one interviewee is the mastermind behind the application, while three others have been involved both in its development and first-hand training of its users. The remaining five TTO interviewees were users without direct involvement in application development. The TTO interviewees ranged in their organizational ranks and were part of licensing, consulting and marketing divisions.

Data collection, analysis, and validity

All informants were alerted to the general topics to be discussed prior to the focus group and interviews in order to give them time to prepare while allowing them maximum freedom in expressing their viewpoints (Flick, 2002). The topics and questions included screening and general individual questions related to organizational roles, perceived adoption drivers and barriers, perceived innovation process performance impacts, and future directions, which were generally based on the themes raised in the focus group. Emerging complementary and relevant issues were also discussed when deemed necessary.

The content of the focus group discussion and interviews were analyzed thematically. Codes were developed as patterns in the data emerged and were helpful in identifying and analyzing patterns of themes (Carson et al., 2001; Miles and Huberman, 1994). Data belonging to each theme were incrementally assembled and viewed in a code-and-retrieve fashion before the themes were triangulated against extant literature and representative quotations were short-listed for illustration purposes.

Construct validity has been adequately addressed in several ways. First, multiple sources of information were used (Yin, 1994). While the focus group and interviews constitute the primary source of information, some of the informants provided supporting secondary data comprising archival documents. Additionally, the investigators themselves identified additional supporting documentation including materials located at the websites of the TTO and university. Relevant secondary data were also used for verifying and triangulating the focus group and interview findings where applicable.

Second, the informants carry out different roles in different disciplines and belong to two different types of organizations, namely, the university and TTO, and therefore, provided different perspectives. Considering different perspectives constitutes an important type of triangulation of qualitative information sources by preventing biased opinions (Choudhrie et al., 2003; Patton, 1990). Third, two of the three investigators conducted and analyzed all focus group and interview data (Denzin, 1989). This kind of triangulation reduces the potential bias, which is commonly cited as a limitation of both qualitative individual and group interviews (Yin, 1994). Finally, the chain of evidence, tracing the conclusions to the focus group and interview summaries, was also maintained. According to Yin (1994), this enhances construct validity as well as the reliability of the research, thereby boosting its overall quality. However, the study reported in this paper is based on one case study in the Australian context. Therefore, its external validity cannot be ensured. Consequently, our findings may not be readily generalizeable beyond this study (Shanks et al., 1993). To ensure generalizeability, further research is required, both in Australia and in other contexts. Such research may either examine the adoption of the innovation application investigated here as it diffuses in

Australia, the United States of America and beyond, or evaluate alternative innovation-focused technologies or applications.

Discussion

Technology acceptance model

All four TA factors discussed in the literature review were identified in the data, including perceived usefulness, ease of use, attitude towards the technology and intention to use it. An overall positive perception was identified in relation to the usefulness of the application in the innovation context. For example, the researchers generally felt that the application was useful and appreciated the considerations that it triggered as well as its scheduling functions and its ability to get concrete and verifiable data to the TTO (Interviewees_researchers#1–4). While research administrators generally confirmed usefulness, their reasoning differed considerably, ranging from using the application as a project management and timetabling tool (Interviewee_administrator#5), to flexibility in handling consulting projects in relation to university–industry engagements (Interviewee_administrator#6). One research administrator summed up the discussion:

> I thought that it looked like a really useful tool that has tremendous potential for commercialization and for triggering the thinking process as well as for consultancies. It is a useful form of keeping data together and from our point of view, it would be great if people could get all their data in and we could pump out all the information. (Interviewee_administrator#6)

The TTO staff consistently described the application as useful in three primary ways, namely, by improving communication, education and reporting. Communication benefits emerge given that the application improves accessibility and consistency of communication as "everyone uses the same words and language" (Interviewee_TTO#9). In relation to communication, the ability to share information and documents were also notable benefits (Interviewees_TTO#10–11). The web-based nature of the application added to its perceived usefulness, as it can be accessed ubiquitously (Interviewee#16).

The educational benefits of the application also emerged clearly from all TTO interviewees and are reflected as Interviewee_TTO#10 states: "It is almost an education process for the researchers as to the types of things they need to start thinking about. And I think that is probably going to be its biggest benefit".

The reporting capabilities of the innovation application were also believed to be useful for all parties involved but were particularly stressed in relation to university management, senior management and strategic planning and monitoring efforts (Interviewees_TTO#13–16). However, interviewees cautioned that reporting would only be useful if the technology were widely adopted within the hierarchical structure of the university, including school, faculty and university levels. The application was also stated to be useful by increasing accountability (Interviewees_TTO#9, 12, 16) and emphasizing structure (Intervewiee_TTO#11).

As expected, perceived ease of use was confirmed as critical for the researchers' attitude towards the application, given that researchers are typically time poor (Interviewees_adminstrator#6, TTO#12,13). The original version of the application was redeveloped to allow researchers to completely upload an innovation project in less than 20 min, which is much faster than invention disclosures that some researchers normally complete. Thus, from the researchers' point of view, the application was generally perceived to be easy to use. Research administrators also felt that ease of use was an important consideration and offered valuable suggestions for improving the progression of screens, navigation, layout, version control and learnability in the future.

All TTO interviewees consistently perceived the application as generally easy to use and user friendly. Although some bugs had been identified, these were attributed to the early stage of application development and were expected to be rectified in subsequent versions. Only one TTO interviewee wished the application could be simplified further in the future (Interviewee_TTO#9). However, the need for researchers to attend a related training workshop, in addition to receiving a

manual, was also stressed (Interviewees_TTO#8, 11). More specifically, the workshop would not only provide the necessary understanding of commercialization processes and the application but also motivate researchers to use it (Interviewee_TTO#10).

> I think the workshop that we do probably will play a much more important role in that adoption process than we currently understand. In other words, not just using the tool but hands on how this all fits together rather than the complexity of some words on the screen. So, in other words, the meaning behind those words and how and why the process works can only really be done in a workshop form. I think we will find that the workshop becomes an integral part of the adoption process. (Interviewee_TTO#9)

When considering the attitude towards the technology, some interviewees were receptive and enthusiastic about using the innovation application, particularly immediately following the workshop training session (Interviewee_administrator#6). Others noted that although the innovation application is beneficial, they stressed that it should be a complimentary point of contact with the TTO and it should not replace face-to-face interactions, a concern uniformly shared by the TTO staff:

> It really is about formalizing the process. I have a little concern that the software takes away the personal face-to-face interaction. As long as it is seen as a tool to support the personal interaction and it is basically an option for [TTO] to review it, then it is fine. But if it is all done electronically, some aspects would be lost as some things need to be done face-to-face. (Interviewee_researcher#1)

In the TTO, the attitude towards the technology appeared to be dependent on the uptake of the researchers (Interviewee_TTO#14). For example, one interviewee mentioned that she would be very positive towards the technology and the use of it, if researchers use it and see value in it (Interviewee_TTO#10). However, there was no universal agreement on this as some interviewees had realized the importance of the TTO staff using the innovation application to ensure that adoption occurred across the university as well: "The key is actually us; the key is us using it" (Interviewee_TTO#8).

Researchers were generally consistent in expressing their intention to use the application (Interviewees_researcher#1–3). For example: "I would use the software in the future. As much as any method to getting the data through to [TTO], it seems like a fair approach" (Interviewee_researcher#3). Administrators also expressed their intention to use the application and refer it to others:

> If I have cause to, I certainly would use the software in the future and I did also run someone else through it and she subsequently passed it over to a couple other researchers from social sciences. One of them became very interested in it and said that he would go and play with it because he liked the organizational aspects [that the application offered] for the consultancies. (Interviewee_administrator#6)

Extension of technology acceptance model for innovation applications

Taking into account the variables attitude to brand and innovation performance, as shown in Fig. 1, two paths were added to TAM, identified as relevant for the adoption of the innovation application in this case study.

Attitude to brand

The attitude of users towards the TTO is an important consideration in the overall adoption of the innovation application, given that the application constituted an extension of the parent brand. It was not only developed by the TTO and carried its name, but it also utilized the face-to-face services of the TTO, providing a different method of delivery and extended features. Both researchers and research administrators generally felt positively about the TTO:

> I have interacted with the [TTO] and the services they provide have been excellent. I could see for some people that [the TTO] would be a very useful avenue if they are seeking linkages or if they need to get an idea of who they should link up with. And for some people it might just be something that grows on their own accord. (Interviewee_administrator#6)

When asked about the attitude researchers have towards the brand of the TTO, TTO staff indicated the existence of a multitude of attitudes, ranging from very positive to quite negative (Interviewees_TTO#13, 15, 16), partly due to the history of the diverse history of the TTO.

When considering the relation between attitude towards the brand to attitude towards the technology, the results show that interviewees felt that their attitude towards the innovation application was influenced by their attitude towards the TTO: "To be honest, my attitude to the software has been influenced by my attitude to [TTO]" (Interviewee_researcher#2). This link was well understood by the TTO staff, as indicated by Interviewee_TTO#12:

> I think it would [impact attitude towards technology]; especially if it is something that [the TTO] is promoting. If they have got a negative feel about [the TTO], then 'that's something else they are doing. I had bad luck with them last time, so I don't want to know what they are doing. I will have the same result; it is not going to be good for me'. So I think it [attitude toward TTO brand] could greatly impact [attitude toward TTO technology]. (Interviewee_TTO#12)

This effect indicated by the data is not surprising, given that the case study deals with a very recent brand extension and the first encounters of individuals with the application. In such situation, the parent brand is known to provide a particularly strong guidance to consumers (Bhat and Reddy, 2001).

Perceived impact on innovation process performance

Given the aim of this paper, it is critical to examine the extent to which the intention to use innovation applications impacts user perceptions on innovation process performance. McAdam et al. (2005) argue that university innovation centers need to focus not only on infrastructure but also on funding and on improving management processes. Furthermore, innovation scholars have stressed that relationships and networks are fundamental in the innovation process (Plewa et al., 2005; Rampersad et al., 2009). Integrating these notions with the work of Chen et al. (2009), innovation process performance can be defined as the extent to which new products or services can be developed and commercialized that are viable and of value to the market; and the capability to establish relationships and secure investment to accelerate these activities.

Interviewees expressed the benefits of the innovation application in securing funding and establishing relationships to advance the R&D and commercialization process. A number of interviewees in the TTO stressed the competitive advantage the innovation application can provide in relation to grant applications, tenders or more generally an improved reputation of the university, which is important in inspiring future relationships and collaborators (Interviewees_TTO#8-10, 16):

> When applying for grants or nominating to be the commercial agent for particular research; if we are in collaboration with other groups; putting ourselves forward as saying that we have a commercialization software in place that can help us progress things, I think puts us ahead of any other university at the moment, because no one has that. (Interviewee_TTO#14)

The interviewees also confirmed that the innovation application contributed to the effective development and commercialization of products and services. The innovation application focuses on key action areas to ensure that innovation viability is addressed by assessing profitability and IP considerations and clearly defining the value to the market (Interviewee_researcher#1 and administrator#6). An increased number of projects disclosed by the researchers using the innovation application and resultant changes in prioritization and efficiency were attributed to the positive influence of technology use on performance (Interviewees_TTO#9, #13). The TTO staff also saw benefits of the use of the technology by describing the positive impact of its adoption on innovation processes (Interviewee_TTO#10) and outcomes: "I think it would greatly improve [the outcome]. . .. It really keeps you on track and just makes sure that you explore every option, which is only going to benefit the project." (Interviewee_TTO#14)

Measuring the constructs

Stemming from the literature review and case study, a number of measures can be suggested for use in future quantitative work for validating the proposed conceptual framework and the manner

and extent to which its constructs concerning attitude to brand, TAM and innovation process performance apply and relate to one another in innovation settings.

Attitude to brand

Despite an extensive and diverse array of measurements in the literature relating to the attitude towards brand, a global concept of brand attitude has been commonly measured by means of sets of attitudinal semantic differentials (e.g. Batra and Stavman, 1990; Rossiter and Percy, 1980). While individual items used to measure attitudes towards brands or organizations may differ (Goldsmith et al., 2002), it was deemed essential for the innovation context to choose items that would account not only for affective but also cognitive evaluations of the brand. Hence, using a semantic differential scale, items proposed for technology adoption in the innovation context may include (1) pleasant/unpleasant, (2) positive/negative, (3) favorable/unfavorable, (4) like/dislike, as well as (5) good/bad, (6) useful/useless, (7) high quality/low quality, (8) beneficial/not beneficial, and (9) valuable/worthless (Batra and Stavman, 1990; Batra and Stephens, 1994). While the first four items relate to a more affective response to the brand, the remaining items have been described to encapsulate a 'more utilitarian evaluation' (Lardinoit and Quester, 2001, p. 53). Nevertheless, depending on the innovation application context in which the scale would be employed, researchers may wish to adapt the items, for example by focusing solely on affect.

TAM constructs

We argue that the scales for operationalizing the original TAM constructs, namely, perceived usefulness and perceived ease of use, adopted in the conceptual framework proposed in this study, can be adapted from the seminal study carried out by Davis (1989). Irrespective of the domain differences, the scales of the original TAM construct lend themselves to a sufficient level of generality, and would, thus, remain generally unaffected by the nature of the innovation management application. Specifically, "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320) does represent perceived usefulness in the innovation context, in the same way as the "degree to which a person believes that using a particular system would be free of effort" (Davis, 1989 p. 320) represents perceived ease of use in the same context. Additionally, for the same reasons, scales for operationalizing 'attitude to technology' and 'intention to use technology' can be adapted from the earlier TAM research as reported in Taylor and Todd (1995b). Clearly, minor wording changes would be required for tailoring these constructs to the target innovation development and commercialization domain.

Innovation process performance

While there is little consensus on innovation performance measures in the literature, measurement of this phenomenon is crucial in moving discussion of theoretical assumptions closer to practice (Adams et al., 2006; Cummings and Teng, 2003; Soosay and Chapman, 2006). Existing measures of innovation success can vary in their emphasis on legal aspects such as patents; technical aspects, for instance technical effectiveness; economic aspects, including R&D expenditure; and social aspects focusing on interaction, relationships and networks (Jensen et al., 2007; Rampersad et al., 2009b). Furthermore, innovation has various outcomes, stages, scopes and durations, and various actors may value different outcomes or combinations of outcomes given their roles at different stages in the innovation process (Spann et al., 1995). To overcome these issues, innovation scholars have employed Juster scales to measure the outcome variable given the seemingly varying views of parties involved (Plewa et al., 2005; Rampersad et al., 2010). Consequently, a Juster scale can be used to allow respondents to rank innovation process performance on a scale from 0% to 100%.

Alternatively, we can adapt the measures proposed by Chen et al. (2009), based on the findings from this qualitative research, to use wording appropriate to the setting and to emphasize relevant dimensions of the innovation process including securing investments and managing relationships. For example, the items can include (1) whether the commercialization pace of the new products or

services is accelerated; (2) whether new products or services are developed; (3) whether the new products or services are profitable; (4) whether the new products or services enhance value to the market; (5) whether investments are secured that accelerate innovation; and (6) whether there is capability to establish and manage relationships to accelerate innovation.

Conclusions and implications

This study contributes to the innovation and technology management literature concerning technologies for managing innovations (Chiesa et al., 2008; Ferrante, 2006; Ragatz et al., 1997). Drawing on qualitative evidence, it validated a conceptual framework for using IT in innovation management, which was developed based on the integration of TA, marketing and innovation management literatures. While much has been written about TA in operational contexts, including supply chain management, customer relationship management, and enterprise resource planning, this study applied TA constructs in an innovation context, which is becoming increasingly pertinent (Cooper, 2003; Damanpour and Wischnevsky, 2006; Dong et al., 2008).

Unlike other studies that incorporate brand experience with basic TAM constructs to investigate the adoption of innovations for personal, leisure, or even domestic purposes (e.g. Qi et al., 2009), or even others that include the impact or technology adoption constructs on perceptions of general organization-wide performance outcomes, we explore the voluntary adoption of an innovation application facilitated by employers and its impact on innovation process outcomes. We do so by incorporating basic TAM constructs with attitude to brand and using qualitative evidence to examine their impact on the individual user's attitude to technology, intention to use and innovation process performance. Therefore, by linking TAM constructs with marketing literature on brand attitude, we address calls for research to combine TA research with other mature research streams (Venkatesh et al., 2003). Additionally, by linking adoption with innovation process performance, we directly respond to calls for further research on this relationship (Goodhue and Thompson, 1995). To the best of our knowledge, this is the first study of its kind in the innovation development and commercialization setting.

In addition to the contributions to the literature, the study also offers important managerial implications. Specifically, findings may be of interest to organizations considering the use of applications for managing innovation. This study has informed understanding of the perceived benefits and risks that impact on the adoption of such applications, which would be insightful for organizations focusing on improving their innovation process management.

Most importantly, however, the proposed conceptual framework can be useful in developing innovation applications and estimating adoption and innovation process success. For example, the joint consideration of perceived usefulness, perceived ease of use, attitude to brand, attitude to technology, intention to use technology and innovation process performance, and their proposed relationships, can help IT practitioners that develop innovation applications predict if a new application will be accepted by potential adopters in the innovation domain and affect innovation process performance. It can also provide diagnostic leads concerning the possible reasons why a new system may not be fully accepted by users and even inform corrective strategies and practical techniques for both evaluating and increasing acceptance (Davis et al., 1989). Additionally, given that organizational inertia is particularly visible in technology contexts (Devaraj et al., 2008), awareness and knowledge of implications prescribed in the proposed conceptual framework might be useful for dealing with new technology introductions and organizational change in innovation contexts.

Perceived benefits of adopting innovation applications

In launch and deployment efforts, management should stress the benefits that innovation applications can provide to prospective adopters in improving efficiency, communication, education and reporting. In terms of usefulness, some interviewees felt that it was educational, as it triggered the thought process. Others viewed the use of the application as an initial phase that should be integrated with training, where relevant, on commercialization, market viability, IP and support in identifying

suitable partners. Consequently, management should stress that innovation applications are merely instrumental and enabling tools and also offer additional training and support as applicable.

Most felt that was important in crystallizing the communication amongst innovation stakeholders that could assist in accountability and verification. At the same time, as researchers also enjoyed the face-to-face interaction, management may also position innovation applications as complimentary tools. The innovation application under investigation was also seen as useful in data gathering, which may have implications for preparing grant applications and tenders. Additionally, its adoption emerged as contributing to the general reputation of the organization. Interviewees felt that the attitude towards the brand, namely, the TTO, impacted on their attitude towards the innovation application, and therefore, management should encourage positive word-of-mouth towards the brand to strengthen the positive associations with the brand amongst the relevant stakeholders.

Perceived barriers of adopting innovation applications

The main barriers that management should address concern ease of use and relevance of setup questions, given the nature of innovation projects and IP considerations. There was consensus amongst interviewees that most researchers are time poor and therefore, it is essential that the application be easy to use by having an intuitive progression between screens, efficient navigation, allowing version control of documentation and being easy to learn. IP issues are a core area of innovation, and therefore, the IP management should be clear and efficient. Consequently, the application should allow stipulation of the mode of commercialization so that innovations for which the organizations own the IP compared to those, which are owned by external collaborators can be treated accordingly and in a timely fashion.

Limitations and future research directions

As with any study, limitations need to be considered in the interpretation of results. First, the study was conducted in the specific context of university research commercialization. Respondents were drawn from university researchers, administrators and employees from the university and related TTO. These particular groups offered useful insights from the perspectives of R&D, administration and marketing that might be transferable to other similar contexts. However, the innovation application researched in this study is intended to be used in a wider variety of organizations including research organizations, businesses, which offer different types of R&D services, and also government grant administrative agencies. Consequently, future studies could be based on additional case studies in various contexts as the innovation application is adopted in these organizations.

Second, another limitation of this study is the early stage of the adoption process related to the innovation application in the case organizations. Further longitudinal studies may offer insights into how adoption changes over time, as the innovation application evolves through its various versions. Furthermore, as the innovation application is deployed throughout an entire organization, it may facilitate more extensive quantitative research to test the conceptual framework and the scales proposed in this study. Such research would serve in strengthening these preliminary qualitative results. Quantitative studies may also facilitate a comparison of different perspectives and rates of adoption amongst R&D, marketing and administration so that promotion or support activities can be developed in light of less than desirable levels of adoption amongst specific groups.

Third, future developments of the application may also facilitate an interface for external partners. Consequently, future research could focus on inter-organizational relationships and relative adoption of innovation applications by different partners. In this manner, the adoption could be investigated in the context of relationships and networks, which form an integral part of the innovation management literature (Collins and Michael, 2006; Johansen et al., 2005; O'Sullivan, 2003). The use of technology in managing innovations is an exciting arena as innovation applications are at a cutting edge of not only the innovations that they support but also at the birth of future developments at this pivotal period given the growing prominence of innovation.

References

Aaker, D.A., Day, G.S., 1990. Marketing Research, 4th ed. Wiley, New York.

Adams, R., Bessant, J., Phelps, R., 2006. Innovation management measurement: a review. International Journal of Management Reviews 8 (1), 21–47.

Adams, D.A., Nelson, R.R., Todd, P.A., 1992. Perceived usefulness, ease of use, and usage of information technology: a replication. MIS Quarterly 16 (2), 227–247.

Adnan, S.M., Ramanathan, K., Chapman, R., 2004. The role of R&D alliances in an era of rapid technological change: some important contemporary issues. In: Proceedings of the 5th CINet conference. Sydney (CDROM).

Agarwal, R., Karahanna, E., 2000. Time flies when you're having fun: cognitive absorption and beliefs about information technology usage. MIS Quarterly 24 (4), 665–694.

Agarwal, R., Prasad, J., 1998. A conceptual and operational definition of personal innovativeness in the domain of information technology. Information Systems Research 9 (2), 204–215.

Arnold, E., Rosh, H., Bessant, J., Hobday, M., 1998. Strategic planning in research and technology institutes. R & D Management 28 (2), 89–100.

Batra, R., Stavman, D.M., 1990. The role of mood in advertising effectiveness. Journal of Consumer Research 17 (2), 201–214.

Batra, R., Stephens, D., 1994. Attitudinal effects of ad-evoked moods and emotions: the moderating role of motivation. Psychology & Marketing 11 (3), 199–215.

Bhat, S., Reddy, S.K., 2001. The impact of parent brand attribute associations and affect on brand extension evaluation. Journal of Business Research 53 (3), 111–122.

Bendoly, E., Citrus, A., Benn, K., 2007. Internal infrastructural impacts on RFID perceptions and commitment: knowledge, operational procedures, and information-processing standards. Decision Sciences 38 (3), 423–449.

Bottomley, P.A., Doyle, J.R., 1996. The formation of attitudes towards brand extensions: testing and generalising Aaker and Keller's model. International Journal of Research in Marketing 13, 165–177.

Bozeman, B., 2000. Technology Transfer and Public Policy: A Review of Research and Theory. Research Policy 29 (4–5), 627–655.

Buenstorf, G., 2009. Is commercialization good or bad for science? Individual-level evidence from the Max Planck Society. Research Policy 38, 281–292.

Buil, I., de Chernatony, L., Hem, L.E., 2009. Brand extension strategies: perceived fit: brand type, and culture influences. European Journal of Marketing 43 (11/12), 1300–1324.

Carson, D., Gilmore, A., Gronhaug, K., Perry, C., 2001. Qualitative Research in Marketing. Sage, London.

Cassell, C., Symon, G., 1994. Qualitative Methods in Organizational Research. Sage Publications, London.

Castellacci, F., 2009. Technological paradigms, regimes and trajectories: manufacturing and service industries in a new taxonomy of sectoral patterns of innovation. Research Policy 37 (6–7), 978–994.

Chapman, R.L., Hyland, P., 2000. Strategy and continuous improvement in small-to-medium Australian manufacturers. Integrated Manufacturing Systems 11 (3), 171–179.

Chapman, R.L., Soosay, C., Kandampully, J., 2003. Innovation and logistic services and the new business model: a conceptual framework. International Journal of Physical Distribution & Logistics Management 33 (7), 630–650.

Chau, P.Y.K., 1996. An empirical assessment of a modified technology acceptance model. Journal of Management Information Systems 13 (2), 185–204.

Chau, P.Y.K., Hu, P.J.-H., 2001. Information technology acceptance by individual professionals: a model comparison approach. Decision Sciences 32 (4), 699–719.

Chen, L., Gillenson, M.L., Sherrell, D.L., 2002. Enticing online consumers: an extended technology adoption perspective. Information & Management 39, 705–719.

Chen, L.D., Tan, J., 2004. Technology adoption in e-commerce: key determinants of virtual stores acceptance. European Management Journal 22 (1), 74–86.

Chen, Y.S., Lin, M.J.J., Chang, C.H., 2009. The positive effects of relationship learning and absorptive capacity on innovation performance and competitive advantage in industrial markets. Industrial Marketing Management 38, 152–158.

Cheng, T.C.E., Lam, D.Y.C., Yeung, A.C.L., 2006. Adoption of internet banking: an empirical study in Hong Kong. Decision Support Systems 42 (3), 1558–1572.

Chiesa, V., Frattini, F., Lazzarotti, V., Manzini, R., 2008. Designing a performance measurement system for the research activities: a reference framework and an empirical study. Journal of Engineering and Technology Management 25 (3), 213–226.

Choudhrie, J., Papazafeiropoulou, A., Lee, H., 2003. A web of stakeholders and strategies: a case of broadband diffusion in South Korea. Journal of Information Technology 18 (4), 281–290.

Collins, J.D.H., Michael, A., 2006. Leveraging tacit knowledge in alliances: the importance of using relational capabilities to build and leverage relational capital. Journal of Engineering and Technology Management 23 (3), 147–167.

Condos, C., James, A., Every, P., Simpson, T., 2002. Ten usability principles for the development of effective WAP and m-commerce services. Aslib Proceedings 54 (6), 345–355.

Cooper, L.P., 2003. A research agenda to reduce risk in new product development through knowledge management: a practitioner perspective. Journal of Engineering and Technology Management 20 (1–2), 117–140.

Crites, S.L., Fabrigar, L.R., Petty, R.E., 1994. Measuring the affective and cognitive properties of attitudes: conceptual and methodological issues. Journal of Applied Social Psychology 20, 619–634.

Cummings, J.L., Teng, B.S., 2003. Transferring R&D knowledge: the key factors affecting knowledge transfer success. Journal of Engineering and Technology Management 20, 39–69.

Czellar, S., 2003. Consumer attitude toward brand extensions: an integrative model and research propositions. International Journal of Research in Marketing 20, 97–115.

Damanpour, F., Wischnevsky, J.D., 2006. Research on innovation in organizations: distinguishing innovation-generating from innovation-adopting organizations. Journal of Engineering and Technology Management 23 (4), 269–291.

Davis, F.D., 1989. Perceived usefulness, perceived ease of use, and user acceptance in information technology. MIS Quarterly 13 (3), 319–340.

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), 982–1002.
Davis, F.D., Bagozzi, R.P., Warshaw, P.R., 1992. Extrinsic and intrinsic motivation to use computers in the workplace. Journal of Applied Social Psychology 22, 1111–1132.
DeLone, W.H., McLean, E.R., 2003. The DeLone and McLean model of information systems success: a ten year update. Journal of Management Information Systems 19 (4), 9–30.
Denzin, N.K., 1989. The Research Act: A Theoretical Introduction to Sociological Methods, 3rd ed. Prentice Hall, Englewood Cliffs, NJ.
Devaraj, S., Easley, R.F., Crant, M.J., 2008. How does personality matter? Relating the five-factor model to technology acceptance and use. Information Systems Research 19 (1), 93–105.
Dong, L., Neufeld, D.J., Higgins, C., 2008. Testing Klein and Sorra's innovation implementation model: an empirical examination. Journal of Engineering and Technology Management 25 (4), 237–255.
Elliot, S., Loebbecke, C., 2000. Interactive, inter-organizational innovations in electronic commerce. Information Technology & People 13 (1), 46–66.
Fang, X., Chan, S., Brzezinski, J., Xu, S., 2005. Moderating effects of task type on wireless technology acceptance. Journal of Management Information Systems 22 (3), 123–157.
Ferrante, C.J., 2006. Innovative sharing: shared accounting information as a facilitator of trust and performance. Journal of Engineering and Technology Management 23 (1–2), 54–63.
Fishbein, M., Ajzen, I., 1975. Belief, attitude, intention and behaviour: an introduction to theory and research. Addison-Wesley, Reading, MA.
Flick, U., 2002. An Introduction to Qualitative Research. Sage, London.
Fontana, A., Frey, J.H., 2000. The interview: from structured questions to negotiated text. In: Denzin, N.K., Lincoln, Y.S. (Eds.), Handbook of Qualitative Research. Sage Publications, Inc., London.
Francis, D., Bessant, J., 2005. Targeting innovation and implications for capability development. Technovation 25, 171–183.
Frankfort-Nachmias, C., Nachmias, D., 1996. Research Methods in the Social Sciences, 5th ed. St. Martin's Press, New York.
Gable, G.G., 1992. Using case studies to strengthen survey research: an example in information systems. In: Third Australian Conference on Information Systems, University of Wollongong.
Galletta, D.F., Henry, R., McCoy, S., Polak, P., 2004. Web site delays: how tolerant are users? Journal of the Association for Information Systems 5 (1), 1–28.
Galliers, R.D., 1990. Choosing appropriate information systems research approaches: a revised taxonomy. In: Nissen, H.-E., Klein, H.K., Hirscheheim, R. (Eds.), The Information Systems Research Arena of the 90s. Perceptions and Alternative Approaches, Copenhagen.
Galliers, R.D., 1993. Research issues in information systems. Journal of Information Technology 8 (2), 92–98.
Gefen, D., Straub, D.W., 2000. The relative importance of perceived ease of use in IS adoption: a study of e-commerce adoption. Journal of the Association for Information Systems 1 (8), 1–28.
Goldsmith, R.E., Lafferty, B.A., Newell, S.J., 2002. The Impact of Corporate Credibility and Celebrity Credibility on Consumer Reaction to Advertisements and Brands. Journal of Advertising 29 (3), 30–54.
Goodhue, D.L., Thompson, R.L., 1995. Task-technology fit and individual performance. MIS Quarterly 19 (2), 213–236.
Gupta, A.K., Wilemon, D., Atuah-Gima, K., 2000. Excelling in R&D. Research Technology Management 43 (3), 52–58.
Gupta, A.K., Raj, S.P., Wilemon, D., 1986. A model for studying R&D-marketing interface in the product innovation process. Journal of Marketing 50 (2), 7–17.
Harris, F., de Chernatony, L., 2001. Corporate branding and corporate brand performance. European Journal of Marketing 35 (3/4), 441–456.
Healy, M., Perry, C., 2000. Comprehensive criteria to judge validity and reliability of qualitative research within the realism paradigm. Qualitative Market Research: An International Journal 3 (3), 118–126.
Hong, S., Kim, J., Lee, H., 2008. Antecedents of use-continuance in information systems: toward an integrative view. Journal of Computer Information Systems 61–73.
Horton, R.P., Buck, T., Waterson, P.E., Clegg, C.W., 2001. Explaining intranet use with the technology acceptance model. Journal of Information Technology 16, 237–249.
Ishman, M.D., Pegels, C., Sanders, L., 2001. Managerial information system success factors within the cultural context of North America and former Soviet Republic. Journal of Strategic Information Systems 10, 291–312.
Jensen, M.B., Johnson, B., Lorenz, E., Lundvall, B.A., 2007. Forms of knowledge and modes of innovation. Research Policy 36 (5), 680–693.
Johansen, K., Comstock, M., Winroth, M., 2005. Coordination in collaborative manufacturing mega-networks: a case study. Journal of Engineering and Technology Management 22 (3), 226–244.
Karahanna, E., Straub, D.W., Chervany, N.L., 1999. Information technology adoption across time: a cross-sectional comparison of pre-adoption and post-adoption beliefs. MIS Quarterly 23 (2), 183–213.
Kaufaris, M., 2002. Applying the technology acceptance model and flow theory to online consumer behaviour. Information Systems Research 13 (2), 205–223.
Keil, M., Beranek, P.M., Konsynski, B.R., 1995. Usefulness and ease of use: field study evidence regarding task considerations. Decision Support Systems 13 (1), 75–91.
Keller, K.L., 1993. Conceptualizing, measuring, and managing customer-based brand equity. Journal of Marketing 57 (1), 1–22.
Keller, K.L, Lehmann, D.R., 2006. Brands and branding: research findings and future priorities. Marketing Science 25 (6), 459–740.
Kim, K.H., Ko, E., Takahashi, I., Schellhase, R., Kim, M.S., Lee, C.H., 2008. A model of adoption of digital multimedia broadcasting (DMB) service: comparisons in Korea, Japan, and Germany. Psychology & Marketing 25 (8), 806–820.
Kinnear, T.C., Taylor, J.R., Johnson, L., Armstrong, R., 1996. Australian Marketing Research. McGraw-Hill Book Company, New York.
Kirmani, A., Sood, S., Bridges, S., 1999. The ownership effect in consumer responses to brand line stretches. Journal of Marketing 63 (January), 88–101.

Kumar, K., van Dissel, H.G., 1996. Sustainable collaboration: managing conflict and cooperation in interorganizational systems. MIS Quaterly 20 (3), 279–299.
Lardinoit, T., Quester, P.Q., 2001. Attitudinal effects of combined sponsorship and sponsor's prominence on basketball in Europe. Journal of Advertising Research 41 (1), 48–58.
Lederer, A.L., Maupin, D.J., Sena, M.P., Zhuang, Y., 2000. The technology acceptance model and the world wide web. Decision Support Systems 29 (3), 269–282.
Lee, H.-H., Fiore, A.M., Kim, J., 2006. The role of the technology acceptance model in explaining effects of image interactivity technology on consumer responses. International Journal of Retail & Distribution Management 34 (8), 621–644.
Leonard-Barton, D., 1990. The Intraorganisational Environment: Point-to-Point Diffusion. In: Williams, F., Gibson, D.V. (Eds.), Technology Transfer: A Communication Perspective. Sage Publications, Newbury Park.
Li, D., Brown, G.J., Chau, P.Y.K., 2006. An Empirical investigation of web site use using a commitment-based model. Decision Sciences 37 (3), 427–444.
Li, H., Daugherty, T., Biocca, F., 2002. Impact of 3D advertising on product knowledge, brand attitude and purchase intention: the mediating role of presence. Journal of Advertising 31 (3), 43–57.
Liker, J.K, Sindi, A.A., 1997. User acceptance of expert systems: a test of the theory of reasoned action. Journal of Engineering and Technology Management 14, 147–173.
Lin, W.-B., 2008. Construction of on-line consumer behavior models: a comparative study of industries in Taiwan. International Journal of Commerce and Management 18 (2), 123–149.
Lin, C.Y., Ho, Y.H., 2007. Technological innovation for China's logistics industry. Journal of Technology Management & Innovation 2 (4), 1–19.
Lowry, P.B., Vance, A., Moody, G., Beckman, B., Read, A., 2008. Explaining and predicting the impact of branding alliances and web site quality on initial customer trust of e-commerce web sites. Journal of Management Information Systems 24 (4), 199–224.
Lu, J., Yu, C., Liu, C., Yao, J.E., 2003. Technology acceptance model for wireless internet. Internet Research: Electronic Networking Applications and Policy 13 (3), 206–222.
Marshall, C., Rossman, G.B., 1989. Designing Qualitative Research. Sage, London.
Martin, C., 2009. Obama's science boost. Current Biology 19 (6), 221–222.
Mathieson, K., 1991. Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior. Information Systems Research 2 (3), 173–191.
McAdam, R., Keogh, W., Galbraith, B., Laurie, D., 2005. Defining and Improving Technology Transfer Business and Management Processes in University Innovation Centres. Technovation 25 (12), 1418–1429.
Melone, N.P., 1990. A theoretical assessment of the user-satisfaction construct in information systems research. Management Science 36 (1), 76–91.
Miles, M.B., Huberman, A.M., 1994. An Expanded Sourcebook: Qualitative Data Analysis. Sage, Thousands Oaks.
Moller, K., Rajala, R., Westerlund, M., 2008. Service innovation myopia? A new recipe for client-provider value creation. California Management Review 50 (3), 31–48.
Nysveen, H., Pedersen, P.E., Thornbjørnsen, H., 2005. Intentions to use mobile services: antecedents and cross-service comparisons. Journal of Academy of Marketing Science 33 (3), 330–346.
O'Sullivan, A., 2003. Dispersed collaboration in a multi-firm, multi-team product-development project. Journal of Engineering and Technology Management 20 (1–2), 93–116.
Park, C.W., Milberg, S., Lawson, R., 1991. Evaluation of brand extensions: the role of product feature similarity and brand concept consistency. Journal of Consumer Research 18 (September), 185–193.
Patton, M.Q., 1990. Qualitative Evaluation and Research Methods, 2nd ed. Sage Publications, London.
Plewa, C., Quester, P., Baaken, T., 2005. Relationship marketing and university–industry linkages: a conceptual framework. Marketing Theory 5 (4), 431–454.
Porter, L., Lawler, E., 1968. Managerial Attitudes and Performance. Irwin-Dorsey, Homewood, IL.
Qi, J., Li, L., Li, Y., Shu, H., 2009. An extension of technology acceptance model: analysis of the adoption of mobile data services in China. Systems Research and Behavioral Science 26, 391–407.
Ragatz, G.L., Handfield, R.B., Scannell, T.V., 1997. Success factors for integrating suppliers into new product development. Journal of Product Innovation Management 14 (3), 190–202.
Raggio, R.D., Leone, R.P., 2007. The theoretical separation of brand equity and brand value: managerial implications for strategic planning. Brand Management 14 (5), 380–395.
Rampersad, G., Quester, P., Troshani, I., 2010. Managing innovation networks: a cross-industry investigation of ICT and nano-bioscience networks. Industrial Marketing Management 39 (5), 793–805.
Rampersad, G., Quester, P., Troshani, I., 2009. Developing and evaluating scales to assess innovation networks. International Journal of Technology Intelligence and Planning 5 (4), 402–420.
Rampersad, G.C., Quester, P.G., Troshani, I., 2009b. Management of networks involving technology transfer from public to private sector: a conceptual framework. International Journal of Technology Transfer and Commercialisation 8 (2/3), 121–141.
Robey, D., 1979. User attitudes and management information system use. Academy of Management Journal 22 (3), 527–538.
Rogers, D.S., Daugherty, P.J., Ellinger, A.E., 1996. The relationship between information technology and warehousing performance. Logistics and Transportation Review 32, 409–421.
Rogers, E.M., 1995. Diffusion of Innovations. Free Press, New York.
Rossiter, J.R., Percy, L., 1980. Attitude change through visual imagery in advertising. Journal of Advertising 9 (2), 10–16.
Ryan, S.D., Harrison, D.A., Schkade, L., 2002. Information technology investment decisions: when do costs and benefits in social subsystems matter? Journal of Management Information Systems 19 (2), 85–127.
Saaksjarvi, M., 2003. Consumer adoption of technological innovations. European Journal of Innovation Management 6 (2), 90–100.
Schläpfer, A., 2009. Hidden biases in Australian energy policy. Renewable Energy 34 (2), 456–460.

Schwartz, N., Clore, G.L., 1996. Feelings and phenomenal experiences. In: Higgins, T., Kruglanski, A. (Eds.), Social Psychology: Handbook of Basic Principles. Guilford Press, New York.
Shanks, G., Rouse, A., Arnott, D., 1993. A review of approaches to research and scholarship in information systems. In: Fourth Australian Conference in Information Systems, Brisbane, Queensland.
Sheppard, B.H., Hartwick, J., Warshaw, P.R., 1988. The theory of reasoned action: a meta-analysis of past research with recommendations for modifications and future research. Journal of Consumer Research 15 (3), 325–343.
Smith, A.M., Fischbacher, M., 2005. New service development: a stakeholder perspective. European Journal of Marketing 39 (9/10), 1025–1048.
Smith, D.C., 2009. Obama: prospects and alternative energy. Renewable Energy Focus (January/February), 88–91.
Song, M., Thieme, R.J., 2006. A cross-national investigation of the R&D-marketing interface in the product innovation process'. Industrial Marketing Management 35 (3), 308–322.
Soosay, C., Chapman, R.L., 2006. An empirical examination of performance measurement for managing continuous innovation in logistics. Knowledge and Process Management 13 (3), 192–205.
Spann, M.S, Adams, M., Sounder, E., 1995. Measures of technology transfer effectiveness: key dimensions and differences in their use by sponsors, developers and adopters. IEEE Transactions on Engineering Management 42, 19–29.
Stone, R.W., Good, D.J., 2001. The assimilation of computer-aided marketing activities. Information & Management 38, 437–447.
Stone, R.W., Good, D.J., Baker-Eveleth, L., 2007. The impact of information technology on individual and firm marketing performance. Behavior & Information Technology 26 (6), 465–482.
Taylor, S., Todd, P.A., 1995a. Assessing IT usage: the role of prior experience. MIS Quarterly 19 (4), 561–570.
Taylor, S., Todd, P.A., 1995b. Understanding information technology usage: a test of competing models. Information Systems Research 6 (2), 144–176.
Thavasi, V., Ramakrishna, S., 2009. Asia energy mixes from socio-economic and environmental perspectives. Energy Policy 37 (11), 4240–4250.
Ticehurst, C.G., Veal, T.R., 2000. Business Research Methods: A Managerial Approach. Pearson Education Pty Ltd., Sydney.
Tsai, Y., Yifu, J., Kurekova, L., 2009. Innovative R&D and optimal investment under uncertainty in high-tech industries: an implication for emerging economies. Research Policy 18 (8), 1388–1395.
Van de Ven, A.H., Rogers, E.M., 1988. Innovation and organisations: critical perspectives. Communication Research 15, 632–651.
Venkatesh, V., 1999. Creating favorable user perceptions: exploring the role of intrinsic motivation. MIS Quarterly 23 (2), 239–260.
Venkatesh, V., 2000. Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model. Information Systems Research 11 (4), 342–365.
Venkatesh, V., Davis, F.D., 1996. A model of the antecedents of perceived ease of use: development and test. Decision Sciences 27 (3), 451–481.
Venkatesh, V., Davis, F.D., 2000. A theoretical extension of the technology acceptance model: four longitudinal field studies. Management Science 46 (2), 186–204.
Venkatesh, V., Morris, M.G., 2000. Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. MIS Quarterly 24 (1), 115–139.
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.
Vroom, V., 1964. Work and Motivation. Wiley, New York.
Walsham, G., 1995. Interpretive case studies in IS research: nature and method. European Journal of Information Systems 4, 74–81.
Wolfe, R.A., 1994. Organisational innovation: review, critique and suggested research directions. Journal of Management Studies 31 (3), 405–431.
Wood, L., 2000. Brands and brand equity: definition and management. Management Decision 38 (9), 662–669.
Wu, C., Lin, L., 2009. Guest editorial. Biotechnology Advances 27 (5), 541.
Wyer Jr., R.S., Clore, G.L., Isbell, L.M., 1999. Affect and information processing. In: Zanna, M.P. (Ed.), Advances in Experimental Social Psychology. Academic Press, San Diego.
Yeung, C.W.M., Wyer Jr., R.S., 2005. Does loving a brand mean loving its products? The role of brand-elicited affect in brand extension evaluations. Journal of Marketing Research XLII (November), 495–506.
Yin, R.K., 1994. Case Study Research: Design and Methods. Sage, Beverley Hills.
Zeithaml, V.A., Gilly, M.C., 1987. Characteristics affecting the acceptance of retailing technologies: a comparison of elderly and nonelderly consumers. Journal of Retailing 63 (1), 49–68.
Zhang, P., Aikman, S.N., Sun, H., 2008. Two types of attitudes in ICT acceptance and use. International Journal of Human–Computer Interaction 24 (7), 628–648.
Zikmund, W., 2003. Essentials of Marketing Research. Thompson South-Western, USA.