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Technology Vision for Radical Innovation and Its Impact on Early Success*

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For firms involved with the very early stages of emergent radical innovation, technical goals are often held in the mind(s) of only one or a few individuals. The way these individuals mentally imagine or visualize such goals, or "technology visions," provides an important looking glass for understanding a firm's progression along the path of involvement from a technical discontinuity toward project-level and organizational-level involvement with a given technology. Utilizing a large sample of firms engaged in radical innovation in North America and the United Kingdom, this empirical study examines the impact of five dimensions of technology vision on early success: benefits goals, efficiency goals, magnetism, specificity, and infrastructure clarity. Technology vision is found to have a significant positive impact on technical competitive advantage, early success with customers, and ability to attract capital, as measures of early success.

Introduction

In competitive global markets, typified by rapid technological change, radical innovation is an important driver of competitive advantage, superior firm performance, and economic growth (Christensen, 1997; De Jong and Vermeulen, 2006). Truly innovative products have the ability to open up new markets, create first-mover advantage, and generate positive cash flows (De Jong and Vermeulen, 2006; Ettlie, 2000; Tellis, Prabhu, and Chandy, 2009). Studies have shown that the successful introduction of new-to-the-world (NTW) radical innovations is the path to survival and enhanced performance for both large and small firms (Cooper, 1993; Mosey, Clare, and Woodcock, 2002). However, developing radical new products can be a long and expensive process. Radical innovations often involve a technology that is embryonic, or one that is new to the firm, and this can involve a great deal of financial risk (Green, Barclay, and Ryans, 1995), capital investment, and market uncertainty (Leifer et al., 2000). Organizations are wary of such risk, investment, and uncertainty, particularly when it involves making important trade-offs (McNally, Billur Akdeniz, and Calantone, 2011), potential cannibalization (Chandy and Tellis, 1998), or has the potential for instigating internal turf wars (Bart and Pujari, 2007). As such, it is often an individual or group of individuals who step in, to solve their own problems, not necessarily considering the organizational-level implications, and in doing so start the radical innovation process rolling for the firm (Reid and de Brentani, 2004; von Hippel, 1986).

Indeed, one of the key challenges in managing technology-enabled radical innovation processes is related to the fact that much of the very early stage thinking and work is driven by one or a couple of individuals and without strategic input or knowledge of the firm (Burgelman and Sayles, 1986; Reid and de Brentani, 2004). They may either work within firms or may be entrepreneurs in the case of start-ups. If such a technology visionary is an entrepreneur, they will often be starting to think about attracting funding to their early ideas; if they are intrapreneurs, or technology visionaries working within firms, they will likely start thinking about attracting internal resources and funding to get the ball rolling.

The thought processes of such individuals early on in emergent technology situations are of interest in our research. Specifically, the key questions are related to "how" the initial goals for working with a given technology are chosen, what they are, and what their impact is. Recent research (Reid and Roberts, 2010, 2011) suggests that this process involves a technology vision (TV), which is defined in this paper as "a mental image held by individual organizational members regarding technical goals related to developing a new technology." Offering a vision of the new technology helps provide direction and

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focus for individuals involved in the early phase of the new product development (NPD) process. Technology vision is, therefore, a key to successfully determining the appropriate path of NPD during the fuzzy front end (FFE) for firms that are engaged in developing radical, high-tech products. As such, the research described in this paper explores the components of technology vision under various firm, competitive, and technological conditions, and its impact on early success.

Objectives and Contribution

A deeper appreciation of technology vision is needed for research and practice as it is an important point of departure for understanding and benefiting from radical innovation. This, in turn, can provide the basis for outstanding company performance (Barney, 1991; Christensen, 1997), and can provide organizations and entrepreneurs with early recognition within both user and investment communities. Important questions emerge that are related to how organizations can develop an effective technology vision. In general, little research has been conducted on vision to date (Brown and Eisenhardt, 1995; Crawford and Di Benedetto, 2000), and that which has is focused on the broader, generic elements of vision, and specifically on organizational vision (Collins and Porras, 1991, 1995; Hamel and Prahalad, 1994; Stokes, 1991), project vision (Lynn and Akgün, 2001), product vision (Tessarolo, 2007), and market vision (Reid and de Brentani, 2010). Yet little is known about technology vision. This is surprising given that technology vision is a precursor to other types of vision within the firm under the scenario of technology-enabled radical innovation, and in terms of its temporal prevalence in guiding overall involvement with the technology through to the market. It is important to understand technology vision as it occurs a priori to market vision, project vision, and then organizational vision; Reid and Roberts (2011) provide a detailed explanation of how this hierarchical order and progression of vision evolves in the case of technology-enabled radical innovation. Individuals involved with the recognition of patterns related to a generic technology are unlikely to be in a position to simultaneously recognize patterns related to potential applications of the technology in the market. As a result, with technology-enabled radical innovation, there is a tendency for the "technology voice" to be initially louder than the "market voice" (O'Connor and Rice, 2001; O'Connor and Veryzer, 2001) as generic technologies lead to applied technologies (Goodman and Lawless, 1994).

Despite its importance and potential to positively influence the outcome of radical innovation, there is a gap in our understanding of what constitutes a technology vision and the technology visioning process. To date, research is scant on the topic, with the exception of the recent exploratory study aimed at determining the key underlying dimensions of technology vision (Reid and Roberts, 2011). Thus, the objectives and contribution of this research are (1) to show that technology vision is a construct that can be measured through underlying dimensions; (2) to test whether and to what extent technology vision impacts early performance; and (3) to test the relationships under various firm, competitive and technological conditions.

In relation to the first objective, this research integrates knowledge on vision from a diverse range of literature,

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including strategy, entrepreneurship, marketing, innovation management, and organizational studies. By pulling together a comprehensive body of vision literature, this enables more fully identifying and developing the core elements and concepts constituting technology vision. Our second objective and contribution relates to the likelihood of new product success engendered by technology vision at the FFE of NPD. Traditionally, a firm's technological capability or potential has been evaluated through patents, new product creation, or through the types of technology services a firm is able to offer. While the marketing discipline has focused primarily on new products as a way of viewing such technological potential, economists have long regarded patents as the most useful index of inventive activity and key to building technological capability (Schmookler, 1966). Similarly, research and development (R&D) expenditures are another important input found to have a strong relationship to patenting (Pakes and Griliches, 1984). Output measures, such as productivity growth, profitability, and stock market value of the firm, are all related to patenting (Griliches, 1990). However, firms engaged in radical innovation need earlier indications of their performance, well in advance of post-market launch metrics, and where possible in advance of some of the inputs, such as patents and R&D expenditures. In some sectors, products may take several years before their launch into the marketplace, either due to technological complexity, regulatory or fund-raising requirements, or the need to be incorporated into other products or services. Thus, early indicators of performance are needed.

While research has increasingly focused on the development of performance metrics (Ambler, 2000; Clark, 2007; Neely, 2007), the majority of literature has concentrated on measuring the success of well-established products, or incremental-type innovations (Oviatt and McDougall, 1994), and in particular utilizing post-launch market metrics. In contrast, in the context of radical innovation prior to market launch, metrics to measure early successes are required. A review of the literature suggests that there are two main early performance metrics: "success with early customers" and the "ability to attract capital" (Reid and de Brentani, 2010). A further early performance metric is that of "technical competitive advantage" (Griffin and Page, 1996). These metrics will be tested and utilized as outcome measures in this study. Finally, a further contribution of this study is that it involves a large, cross-national (North American [NA] and United Kingdom [UK]) sample of firms of different sizes and with different resource capabilities involved in developing a variety of new industrial technologies; this enables testing the key relationships of interest under various firm, competitive, and technological conditions. It also allows for generalization about the factors that make up technology vision and its impact on early success.

Theoretical Background

A topic of interest in both the academic literature and the popular press is that of the "charismatic" (Baum, Locke, and Kirkpatrick, 1998) or "visionary" (Tellis, 2006) leader. Visionary leaders, such as Bill Gates, the founder of Microsoft, and Steve Jobs, the cofounder of Apple, are often quoted as examples of men who have advanced technology, and have inspired and captured the imagination of their customers and employees. In common with other visionaries has been their ability to envisage a new kind of future, extending the boundaries of what is possible, sharing their vision, and building a sense of purpose around it. In doing so, the resulting innovations have enriched and transformed peoples' lives and have revolutionized the marketplace. In mature markets particularly, this type of radical innovation and what Cooper (2011) terms "bold innovation" is needed, as it generates breakthrough products that create growth engines for the future. Success in this field requires "visionary leadership" (Tellis, 2006), which in turn relies on a shared vision. Vision is often discussed generically, but it is necessary to develop a more fine-grained understanding of what constitutes a technology vision under different contexts, such as in the case of technology-enabled radical innovation. As such, an examination is conducted of the basic concepts of visionary leadership, vision, and then how they relate to TV.

Basic Concepts of "Visionary Leadership," "Vision," and "Technology Vision"

A genre of leadership theories has emerged alternatively labeled "charismatic," "visionary," and "transformational" leaders (Bass, 1985; Baum and Locke, 2004; Baum et al., 1998; Gumusluoglu and Ilsev, 2009; Jung, 2001). Despite differences in emphasis, there is convergence in the findings (Baum et al., 1998; Dvir, Eden, Avolio, and Shamir, 2002) around the concept of vision. Transformational leaders concentrate on long-term goals and place great value and importance on developing a vision, thereby inspiring followers to transcend their own self-interest to pursue the vision (Howell and Avolio, 1993; Jung, Chow, and Wu, 2003; Shamir, House, and Arthur, 1993). Other common themes center on leaders' ability to communicate a vision and to take action to implement the vision, where necessary changing or aligning systems, to accommodate the vision (Baum et al., 1998; Howell and Avolio, 1993).

By developing a view of the future, and inspiring and motivating their followers, visionary leaders raise performance expectations and improve innovation within the organizational context (Bird, 1992; Filion, 1991; Gumusluoglu and Ilsev, 2009; Jung et al., 2003; Larwood, Falbe, Kriger, and Miesing, 1995). However, what is important is the vision itself (Kirkpatrick and Locke, 1996) as this was found to exert more influence on followers, and in the case of new ventures (Filion, 1991) and in entrepreneurial firms (Baron and Hannan, 2002; Breugst, Domurath, Patzelt, and Klaukien, 2012) the commitment of followers is a critical success factor. The literature also distinguishes rapid-growth from slow-growth new ventures as having significantly more focus on growth-oriented vision (Barringer, Jones, and Neubaum, 2005; Doorley and Donovan, 1999). Similarly, vision has also been found to be important for mature, well-established firms (Kotter, 1999; Westley and Mintzberg, 1989). Following, the potential components of technology vision are considered.

Measures

Intrinsic Dimensions of Technology Vision

Intrinsic components of vision denote what the vision itself looks like and what it represents to members of an organization (Reid and de Brentani, 2010). First, it is important that the technology must have clear *goals* related to its development (Sengupta, 1998; Tripsas, 2000). As a result, items were included that would measure technology vision goals. Second, Collins and Porras (1991, 1995) propose the idea of a guiding philosophy for the organization where the purpose is "to grab the soul" of each organizational member. When entrepreneurs are perceived to be "passionate" about inventing by their employees, this has a positive influence on their commitment (Breugst et al., 2012). In order to tap into this, items were developed that were believed to be part of technology vision *magnetism*. Given the importance of key individuals in initiating a firm's involvement with a given technology, the technology vision must have this inherent magnetic quality to motivate and drive these individuals and their followers forward.

Extrinsic Dimensions of Technology Vision

Previous research in the areas of organizational and project vision has contributed, in part, to our understanding of what have been termed in Reid and de Brentani (2010) as the *extrinsic* factors of vision. These are components that describe, but are external to, the essence of the vision itself. Lynn and Akgün (2001) showed that vision *clarity* is important, especially for radical innovation projects; the earlier work of Hamel and Prahalad (1994) and Nanus (1992) also supports this. Vision clarity "refers to having a well-articulated, easy-to-understand target—a very specific goal that provides direction to others in the organization" (Lynn and Akgün, 2001, p. 375). Given the importance of technology vision to early guidance of technology-enabled NPD programs, this suggests that vision clarity related to the technology infrastructure (human resources, capital equipment, facilities, patents, processes) required for growth is important to getting up and running with a certain technology and offers the potential to facilitate early co-creation efforts with customers and suppliers (Prahalad and Ramaswany, 2004; Roberts, Baker, and Walker, 2005; Seybold, 2006). In new ventures, as well, establishing a pathway for accessing resources is seen as an important building block (Song and Di Benedetto, 2008; Timmons and Spinelli, 2004). Establishing clarity regarding what infrastructure will be required early on can help facilitate scale-up in the future and takes the emphasis off internal fights for resources later, when budgets may need to move to marketing and other areas.

Research on organizational vision (Collins and Porras, 1991, 1995) also proposes that in order for clarity to be achieved, a goal needs to be tangible—or as suggested—a vivid description of the goal of the organization that helps make the mission more alive by providing a vibrant, engaging, and specific description of what it will be when it is achieved. As such, items were developed that related to technology vision *specificity* as one potential dimension of technology vision.

In sum, the conceptual framework, comprising the underlying dimensions of TV, is hypothesized to include TV goals, TV magnetism, TV clarity, and TV specificity (H1) (see Figure 1).

Early Success

In the same way that radical innovation is attracting much academic and practitioner attention, business performance is also high on the corporate agenda, and new methods of measurement have attracted the attention of the business community (Clark, 2007; Neely, 2007). Increasingly, it is being recognized that performance measures can provide far more than just a progress check, and that there are also behavioral consequences of

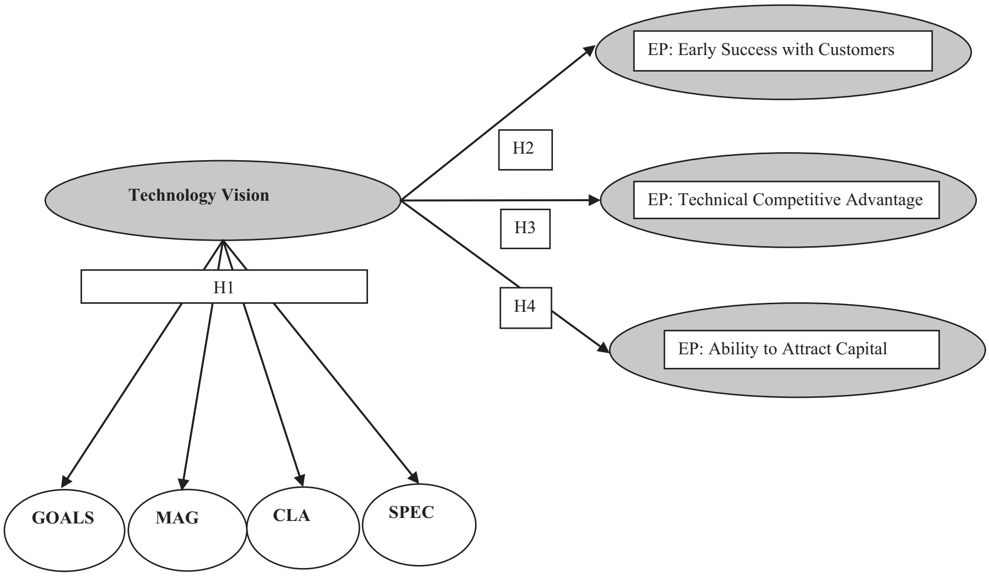

Figure 1. Model of Hypothesized Structural Relationships

performance measurement (Kerssens-van Drongelen, Nixon, and Pearson, 2000). Measures can be used in different ways by decision-makers; for instance, they can be used to gain an understanding of the environment, to predict and thus enable planning, and act as a motivational tool (Park, Goethert, and Florac, 1996). Ambler (2000), for example, uses the analogy of top athletes who use measurement to motivate themselves to higher levels of performance. In complex projects, such as those in NPD, using the right performance measurement can promote communication and coordination among managers (Kerssens-van Drongelen et al., 2000). Within the context of innovation management, there has been an increase in the number of different tools and techniques that are being used as aids to improve performance (Hustad, 1996; McDonough and Griffin, 1997). However, as noted by Kerssens-van Drongelen et al. (2000), the use of performance metrics is contingent on context, and the use of standard performance tools is not necessarily relevant in the very early stages of the process where technology visioning takes place.

It is, however, important that firms are able to evaluate performance at some level, even early on in the FFE of the radical innovation process, and use this information to help gain commitment, both internally and externally, for the technology vision. This becomes more pertinent when examining the findings of NPD best practice studies (Cooper and Kleinschmidt, 1995; Griffin, 1997), which demonstrate that "measuring performance" was one of the discriminating factors between the "best" and the "rest." Indeed, Katila (2007) suggests three reasons why the study of the early success measurement for radical innovation projects is important. First, radical innovations enhance firms' performance, and companies that are able to develop technologically radical innovations have the potential to become market leaders. Second, the concept of radical innovation is increasingly being studied in new research areas, such as those that focus on collaborative relations and networks and require new approaches to measurement. Third, and of importance to this study, is the fact that, despite the importance of radical innovation, there is comparatively little work on how to measure radical innovation. The majority of published metrics is tightly specified and focused on current operations, which is the antithesis of development work in the front end of radical innovation projects.

A review of measures for NPD success was undertaken by Griffin and Page (1993), who found that practitioners and researchers used 75 different measures for NPD success and failure. Further studies performed by Griffin and Page (1996) and Hultink and Robben (1995) revealed the typical project-level measures of success included market share, revenue, revenue growth, unit volume, number of customers, profitability, margins, internal rate of return (IRR), return on investment (ROI), break-even time, speed to market, total development cost, and time to launch. While well established, the use of the above standard financial reporting measures becomes problematic in the case of radical innovations, which can be in development for 10 years or more and can have a number of applications. Since technology vision deals with the early, pre-project stages of radical innovation, most of the standard measures of project-level performance are inappropriate. Not only are most of these measures temporally far removed from the front end of NPD, but for many companies interviewed for this research they have not launched products yet, and so these measures are not relevant or meaningful for them.

It is important that organizations and potential investors in those organizations are able to distinguish winning initiatives at an early stage. One of the challenges, therefore, is that it is important for organizations to make decisions that will lead to strong early success; at the same time, only limited theory exists regarding how to evaluate performance during and as a direct result of activities in the FFE. Given this, insights from Griffin and Page's (1996) success measurement study were utilized, which found that both customer satisfaction and acceptance are important metrics for rating success with "new to the world products." Therefore, "early success with customers," was used as an outcome measurement to develop an early success metric for radical innovation that would provide meaningful outcomes in the case of technology vision. Further impetus for using "early success with customers" comes from von Hippel's (1976) lead user concept. Lead users face needs that will not become general in the market for many months or years, and are positioned to benefit significantly from obtaining a solution to those needs (von Hippel, 1986, 2005). It is, therefore, likely that they will be drawn to those suppliers/manufacturers who look like they hold promising ideas for successful product delivery in the future. As such, satisfaction and acceptance by early customers, such as lead users, provide early success measures for understanding the future promise held within technology vision. The "early success with customers" measure developed by Reid and de Brentani (2010) was used for this research. Specifically, it was hypothesized that technology vision has a positive and significant impact on early success with customers (ESC) (H2).

Griffin and Page's (1996) measurement study also points to a second important measure that could be applied in the case of NTW products, that of "technical competitive advantage." This measure takes into account the product's innovativeness, performance, and quality specifications, and was rated the third most effective measure in the case of NTW products. Another advantage of utilizing technical competitive advantage as an early success item is related to the temporal issue that it can be utilized during the early stages of FFE of NPD with radical innovations. Given that developing a technology vision is a logical precursor to developing a technical competitive advantage, it was hypothesized that technology vision has a positive and significant impact on technical competitive advantage (TCA) (H3).

Lastly, a company's ability to attract capital provided the basis to develop a metric for the performance of a technology vision. The impetus for this idea comes from the literature dealing with the importance of venture capital (Hellmann and Puri, 2000; Kaplan and Stromberg, 2004; Zider, 1998), particularly for entrepreneurial start-ups (Timmons and Spinelli, 2004). New ventures need to market their ideas "upstream" to potential investors, such as venture capitalists, incubators, corporate partners, and institutional investors (Song and Di Benedetto, 2008). Venture capital firms specialize in identifying emerging technologies and market opportunities. Thus, to gain their interest and backing, the ability to attract capital can be used as a proxy indicator of the value of the technology vision. The ability to attract capital metric, as developed by Reid and de Brentani (2010), was used for measurement in their study on market vision, which found that the presence of a market visioning competence was strongly and positively linked with the ability to attract capital. Similarly, it is hypothesized here that technology vision is likely to have a significant positive impact on the ability to attract capital (AAC) (H4). As such, it is necessary to theoretically investigate the likelihood that TV separately impacts each of ESC, TCA, and AAC.

Hypotheses

To summarize, the main goal of this research was to examine how to best measure the underlying dimensions comprising the technology vision itself (H1), and then to determine the relationship between TV and early success in terms of three measures thereof: ESC (H2), TCA (H3), and AAC (H4). The general model of hypothesized structural relationships is outlined in Figure 1.

Methodology and Results

Stage 1: Qualitative Research (Item Generation for the Technology Vision Scale)

A combined literature and exploratory interview approach was used to develop a theoretical framework for empirically investigating the technology vision construct in an ecological framework. Specifically, a combination of qualitative, in-depth interviews was used with experts and academics in order to ensure the best possible understanding of the various dimensions underlying the concept. The literature review elicited related vision concepts and existing scales (from the organizational, project, and market levels) and theory related to the realm of technology-enabled radical innovation, and how it unfolds, in the early stages within a given firm. This was further refined with input from 30 in-depth personal interviews with high-tech industry experts (e.g., senior managers/CEOs from high-tech firms, venture capitalists involved with radical innovations) as per Bearden, Hardesty, and Rose (2001). Additionally, qualitative case evidence was considered from a study by Livingston (2007) of 20 high-tech company founders related to the early days of their technology development. As a result, the notion of "goals" was further developed with interviewees and classified into two typical types: those leading to *benefits* and those leading to lower costs (*efficiencies*). For example, Mike Lazardis of "Research in Motion" noted that while the wireless benefit to e-mail was realized as critical early on, the value was limited by the packaging and limitations of the technology of that time, and so they started working specifically on the efficiency goal in order to deliver better overall value at the end of the day to whoever their customers ended up being (Livingston, 2007); of course, while this "interactive pager" was developed primarily for speeding up communication in industrial sales, it eventually became a must-have tool creating initially unforeseen benefits for the mass market. This distinction of goals being of two types, efficiency goals and benefits goals, was reiterated in many of the expert interviews conducted. For example, one expert emphasized that an important component of a good technology vision was related to "the ability to eventually realize significant cost savings." At the same time, this expert also emphasized that another goal must involve focusing on "key benefits which could either better satisfy existing customers or attract new customers." Another issue highlighted was that the technology vision needs to have the potential to impact others, and therefore has a role to play in terms of offering direction ("specificity") to others in the organization beyond the initial founder, entrepreneur, or tech visionary. Finally, one expert made an interesting observation that in addition to clarity regarding the technology itself and its benefits, it was very important very early on that the requirements of the infrastructure that would be needed to get things up and running be part of that vision (i.e., human resources, facilities, how much it would cost to develop the technology). This "infrastructure clarity" factor and related items eventually became a key factor that was maintained throughout the analyses. As such, through the combined literature review/expert interview process, a total of 157 items was developed for use in the first study (for the purposes of exploratory factor analysis [EFA]): 6 demographics questions, 4 manipulation checks for level of innovativeness of the innovation to ensure a high enough level of radicalness, 16 classification questions, 104 potential items for measuring technology vision (based on the item generation process described above), and 27 early performance items. All classification, manipulation check, TV, and early performance (EP) items were measured using 7-point Likert scales, with the exception of three classification questions: firm size, country-of-origin, and industry.

Stage 2: EFA and Item Purification with Sample One

The first survey was administered via combined telephone/e-mail interviews to a sample of NA firms, based across a broad range of several high-tech industries, including electronics, biopharmaceuticals, energy, and sustainability technologies ($n = 100$; response rate = 23%). The general aim was to reach CEOs, chief technology officers (CTOs), and directors of R&D, as these are the individuals typically available for both small and large organizations. In small firms, the CEO or CTO was often the person who worked directly with the technology, and in larger firms it was the CEO, CTO, or project manager. Respondents were asked to only participate if they had been involved in the early stage development of one "high-tech" (> 6% according to the definition provided by Riche, Hecker, and Burgan, 1983) and "radical innovation," as per the operational definition provided by Leifer et al. (2000): any innovation that improves performance by at least 5–10 times reduces costs by > 30%, and/or is considered NTW. Specifically, both the cover e-mail and first page of the questionnaire were designed to highlight these criteria; further, four manipulation check questions were also aimed at verifying that this was indeed the case.

In order to refine the list of items to be used to measure TV, TCA, ESC, and AAC, data were assessed using an EFA (maximum likelihood estimation, Oblimin) utilizing SPSS (version 17; SPSS, Inc., Chicago, IL, USA), following the methods of Bearden et al. (2001), Bollen and Lennox (1991), and DeVellis (1991).

Stage 2: EFA Results

The EFA conducted on the first sample revealed that technology vision potentially comprised 12 underlying factors represented by a total of 40 items. Further analysis conducted to test the underlying structure of the 12 initial factors demonstrated that 2 of the 12 factors did not have strong enough reliability (based on alpha values) to be carried through to the confirmatory factor analysis (CFA) phase, and therefore were dropped from further consideration, leaving 10 factors with 34 items for the next phase of testing. Details of the full development of the test instrument are available in Reid and Roberts (2011). Additionally, nine early success items clustered on three factors (Cronbach's alphas for all factors > .7).

Stage 3: CFA with Sample 2

Based on the findings of the EFA, a refined list of 34 technology vision items was used to develop the questionnaire for use with the second sample of primarily biotechnology and nanotechnology companies from the UK. Of 104 questionnaires received (16.1% response rate), 94 were complete and met the manipulation check standards related to level of innovativeness required by the study. Mardia's tests were performed on the 94 cases and indicated that the data were slightly kurtotic, but did not show signs of extreme kurtosis, and so a moderate item-to-respondent ratio in the range of 1:6 or 1:7 was considered to be adequate for testing (DeVellis, 1991). According to the exploratory analysis, after removing two borderline components, 10 components remained. Theoretically, these 10 components were divided into four subdomains, so that the subdomain with the largest number of items was that of TV goal, with a total of 10 items. As such, using a moderate item-to-response ratio of 1:7, based on 10 items, the sample size of 94 was considered more than adequate to perform the required tests. All remaining 34 items comprising the 10 components were subjected to a CFA enabling verification of the underlying dimensions of technology vision, and also allowing the researchers to check the validity, reliability, and significance of these dimensions, in addition to those of the early performance metrics.

Stage 3: CFA Results

From the original 12 EFA factors to measure TV (and 10 administered here, as described), five factors (encompassing a total of 16 items) were found to be significant reflective first-order factors loading on TV, a second-order factor, and were retained in the CFA, and these gave a comparative fit index (CFI) = .975 and root mean square error approximation (RMSEA) = .045. These results support the existence of a complex second-order reflective model for measuring technology vision. The results of the loadings and reliabilities (Cronbach's alphas) are provided beside the abbreviated title for each item for the second order model of TV in Table 1. Discriminant analysis was also performed between each of the TV factors using a chi-square difference test, and the results showed adequate discrimination. Further, the factor average variance extracted (AVE) value in each case is > .50, reliability is > .70, and the discriminant validity between the factors is strong, with squared correlations much lower than the AVE value in each case, and therefore according to the criteria outlined by Green et al. (1995) the convergent validity for TV is also considered acceptable.

Stage 4: Structural Equation Modeling (SEM) Analysis with Sample 3

Estimation of three models each including one outcome factor, to test H2, H3, and H4, was performed based on SEM methods (Anderson and Gerbing, 1988; Bagozzi, 1984; Bollen, 1989) utilizing EQS software (version 6.1; Multivariate Software Inc., Encino, CA, USA). The indicators used to get a sense of model fit included (1) comparative fit index utilizing CFI > .90 as an acceptability criterion (Hu and Bentler, 1999) and (2) root mean square error approximation utilizing RMSEA < .07 as a cut-off point (Browne and Cudeck, 1993). The data set used for the third sample included a combination of 129 firms from the UK and 84 from NA from primarily the biotechnology and nanotechnology sectors. Seven of the UK firms and two of the NA firms were removed from the analysis due to not meeting the requirements of "radicalness" and "high-tech," and a further four UK firms were removed for contributing to unduly high kurtosis of the data, thereby leaving a total of 118 UK and 82 NA firms for the SEM, or in other words a total of 200 firms. The same contact methods, qualifications, and manipulation check questions were used here as with the CFA. Further, this final sample, which was used to test the model, was almost evenly split between small ventures with less than or equal to 10 employees (100/200 respondents) and larger firms with greater than 10 employees (100/200). As such, the model is generalizable to both entrepreneurial and within-firm intrapreneurial technology vision (this was also later tested and confirmed using firm size as a control variable). Prior to running the SEM, the alpha values and loadings of the early performance factors (ESC, TCA, and AAC) were verified with the final sample, as they had been developed in previous research. As shown in Table 2, the factors showed adequate (> .7) loadings and reliability (Cronbach's alphas), and therefore were acceptable to continue the analysis. The full version of the TV scale items and EP items is available in the Appendix.

Stage 4: SEM Results

First, the SEM results reconfirm the results from the CFA that each of the final five components of technology

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Table 1. (H1) SEM Standardized Estimates and Probabilities of TV Based on CFA Analysis

First-Order TV Paths Tested	Standardized Estimate
Benefits goal (alpha = .95)	
HowtoMakeThingsMoreConvenient	.990* (λ1)
HowtoMakeThingsEasier	.950* (λ2)
HowtoMakeThingsMoreUserFriendly	.869* (λ3)
Efficiency goal (alpha = .73)	
About_CheapInc	.854* (λ4)
About_HowIncMoreCheaply	.716* (λ5)
About_HowSolveEco	.547* (λ6)
Magnetism (alpha = .80)	
Goal of tech was attractive	.776* (λ7)
Goal of tech was desirable	.787* (λ8)
Goal of tech was compelling	.715* (λ9)
Specificity (alpha = .89)	
Early techvision tangible	.887* (λ10)
Early techvision clear	.889* (λ11)
Early techvision specific	.905* (λ12)
Early techvision provide direction	.619* (λ13)
Infrastructure clarity (alpha = .82)	
Clear what facilities needed	.822* (λ14)
Clear what HR needed	.968* (λ15)
Clear cost to develop	.605* (λ16)
Second-Order TV Paths Tested	**Standardized Estimate (*t*-value)**
TV to technology vision benefits goal	.364 (2.669)*
TV to technology vision efficiency goal	.561 (3.596)*
TV to technology vision magnetism	.576 (3.918)*
TV to technology infrastructure clarity	.427 (2.765)*
TV to technology vision specificity	.496 (3.343)*

* $p < .05$.
CFA, confirmatory factor analysis; HR, human resource; SEM, structural equation modeling; TV, technology vision.

vision (benefits goal, efficiency goal, magnetism, specificity, and infrastructure clarity) is significantly linked to the second-order technology vision construct as hypothesized (H1). Second, H2, H3, and H4 were confirmed as the paths from TV to each of ESC, TCA, and AAC were significant, and these are each described in turn below.

Table 2. Reliability Results for Early Performance (ESC, TCA, AAC)

	Factor Loadings
Early success with customers (alpha = .79)	
Early acceptance	.838
Early satisfaction	.825
Customer needs	.616
Technical competitive advantage (alpha = .78)	
Innovation value	.799
Technical quality	.782
User benefits	.649
Ability to attract capital (alpha = .74)	
Cash flow	.807
Capital	.659
Employment	.657

AAC, ability to attract capital; ESC, early success with customers; TCA, technical competitive advantage.

Path Model: Technology Vision and Its Impact on ESC

The structural model for TV and its impact on ESC produced a chi-square of 212.544 with 145 degrees of freedom. The CFI was .965 and the RMSEA was .048. The EQS standardized estimates of the parameters (H1) for the model, including ESCs and the standardized estimate for the structural relationship between TV and ESC (H2), are presented in Table 3. As shown in the table, the main structural relationship was significant at $p < .05$ ($t > 1.645$) (Anderson and Gerbing, 1988). These findings support the quality of the structural equation model and suggest that the structural model fits the data. According to the results, technology vision has a strongly positive impact on ESCs ($\lambda = .403$, $t = 2.906$.). This result supports H2. In particular, the underlying dimensions of technology vision that relate to goals create a focus of the

Table 3. (H2) SEM Standardized Estimates and Probabilities of TV Construct and Path to ESC

	Standardized Estimate (*t*-Value)
Second-order TV paths tested	
TV to technology vision benefits goal	.360 (2.842)*
TV to technology vision efficiency goal	.379 (2.841)*
TV to technology vision magnetism	.388 (3.999)*
TV to technology vision infrastructure clarity	.376 (2.809)*
TV to technology vision specificity	.778 (3.203)*
First-order path tested	
TV to ESC	.403 (2.906)*

* $p < .05$.
ESC, early success with customers; SEM, structural equation modeling; TV, technology vision.

vision about delivering unique benefits or economies of scale. Therefore, if individuals in firms are focused on this, it plays out in terms of ESC likely because it means that even from a very early stage, before considering the specifics of market involvement, the technology visionary is focused at a broad level from the beginning on solving customer and user needs.

Path Model: Technology Vision and Its Impact on TCA

The structural model for TV and its impact on TCA produced a chi-square of 221.092 with 145 degrees of freedom. The CFI was .960 and the RMSEA was .051. The EQS standardized estimates of the parameters (H1) for the model, including TCA and the standardized estimate for the structural relationship between TV and TCA (H3), are presented in Table 4. As shown in the table, the main structural relationship was significant at $p < .05$ ($t > 1.645$) (Anderson and Gerbing, 1988). These findings support the quality of the structural equation model and suggest that the structural model has a good fit to the data. According to the results, technology vision has a strongly positive impact on TCA ($\lambda = .399$, $t = 2.905$). This result supports H3. Because of the underlying dimensions of technology vision related to developing the technology itself, part of the focus of the vision is about delivering unique benefits or economies of scale in a well-defined infrastructure for the future and providing good drive for the instigator. Therefore, if individuals in firms are focused on these issues, it plays out in terms of TCA.

Path Model: Technology Vision and Its Impact on AAC

The structural model for TV and its impact on AAC produced a chi-square of 204.805 with 145 degrees of freedom. The CFI was .967 and the RMSEA was .046. The EQS standardized estimates of the parameters (H1) for this model with AAC and the standardized estimate for the structural relationship between TV and AAC (H4) are presented in Table 5. As shown in the table, the main structural relationship was significant at $p < .05$ ($t > 1.645$) (Anderson and Gerbing, 1988). These findings support the quality of the structural equation model and suggest that the structural model has a good fit to the data. According to the results, technology vision has a strongly positive impact on AAC ($\lambda = .203$, $t = 1.907$). This result supports H4. Again, because of the underlying dimensions of technology vision, the technology visionary is focused in such a way that while they may not yet have a complete technology solution focused on a specific market, they do have specific goals related to developing the technology and are passionate about what

Table 4. (H3) SEM Standardized Estimates and Probabilities of TV Construct and Path to TCA

	Standardized Estimate (*t*-Value)
Second-order TV paths tested	
TV to technology vision benefits goal	.303 (2.617)*
TV to technology vision efficiency goal	.392 (2.954)*
TV to technology vision magnetism	.559 (3.290)*
TV to technology vision infrastructure clarity	.422 (3.999)*
TV to technology vision specificity	.652 (3.458)*
First-order path tested	
TV to TCA	.399 (2.905)*

* $p < .05$.
SEM, structural equation modeling; TCA, technical competitive advantage; TV, technology vision.

Table 5. (H4) SEM Standardized Estimates and Probabilities of TV Construct and Path to AAC

	Standardized Estimate (*t*-Value)
Second-order TV paths tested	
TV to technology vision benefits goal	.348 (3.631)*
TV to technology vision efficiency goal	.475 (4.689)*
TV to technology vision magnetism	.437 (3.996)*
TV to technology vision infrastructure clarity	.427 (4.230)*
TV to technology vision specificity	.668 (6.129)*
First-order path tested	
TV to AAC	.203 (1.907)*

* $p < .05$.
AAC, ability to attract capital; SEM, structural equation modeling; TV, technology vision.

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they are doing; this translates well when attracting capital from potential investors (AAC).

Stage 5: Control Variables Analysis

The most common competitive (country, industry), firm (firm size, resource availability), and technological (appropriability, complexity) variables that might be related to changes noted in studies involving high-tech firms (Reid and de Brentani, 2012) were tested to verify whether they contributed to any of the effects noted in the study. As such, the following variables (operationalized measures in parentheses) were controlled for in this study in order to determine whether there were control variable effects: country (UK, NA), industry (biotechnology, nanotechnology, high-tech "other," or nanobiotech), firm size (number of employees—small/large), firm resource availability ("We had the necessary equipment in the early stages of the development of this technology" and "We had the necessary financial resources in the early stages of the development of this technology"—low/high), appropriability ("We are [will be] using patents to protect this technology"—low/high), and complexity ("We were slow to adopt/develop this technology because it was very complex"—high/low). In order to investigate whether these variables impact the main variables of interest in the study (i.e., the TV construct, the first-order TV factors, and the EP factors ESC, TCA, and AAC), each of the control variables was introduced one at a time. Using analysis of variance tests, potential differences in the factors of interest in this study, potentially attributable to the control variables, were tested.

Stage 5: Control Variables Results

An examination was conducted to test whether there were any significant differences for each of the six control variables across the nine factors of interest (the five first-order factors of TV, TV itself, and the three early performance factors) (see Tables 6–8 for results).

For the majority of the relationships tested, no statistically significant differences were observed across the clusters. However, the only control variable that had no impact across the board was the industry control. In each of the other cases, there was at least one significant difference across the factors per control variable. In the case of the firm-level control variables, *firm size* showed a difference for the goals, whereby small firms had more of an emphasis on both benefits and efficiency goals with their TV than large firms. As well, firms with higher levels of *resource availability* appeared to have higher levels of TV

Table 6. ANOVA Test Results for Competition Control Variables

	Competition Control Variables							
	Country			Industry				
Constructs	U.K. Mean ($n = 118$)	NA Mean ($n = 82$)	ANOVA (Sig.)	Biotech Mean ($n = 52$)	Nanotech Mean ($n = 62$)	High-Tech Other Mean ($n = 67$)	Nanobio Mean ($n = 19$)	ANOVA (Sig.)
TV first-order dimensions								
F-1 TV benefits goal	4.54	4.41	.264 (.608)	4.57	4.42	4.37	4.84	.421 (.738)
F-2 TV efficiency goal	4.26	4.94	9.370 (.003)**	4.40	4.83	4.45	4.30	1.034 (.378)
F-3 TV magnetism	5.36	5.35	.005 (.943)	5.39	5.47	5.33	5.00	.804 (.493)
F-4 TV specificity	5.36	5.36	.000 (.993)	5.47	5.16	5.40	5.57	.851 (.468)
F-5 TV infrastructure	4.64	4.55	.254 (.615)	4.72	4.58	4.54	4.60	.220 (.883)
TV second-order construct	4.83	4.92	.546 (.461)	4.91	4.89	4.82	4.87	.138 (.937)
Early performance outcome factors								
ESC early success with customers	5.12	5.01	.309 (.579)	5.01	5.15	5.02	5.21	.215 (.886)
TCA technical competitive advantage	5.80	5.91	.717 (.398)	5.81	5.91	5.85	5.67	.384 (.765)
AAC ability to attract capital	4.85	4.59	1.899 (.170)	4.75	4.97	4.57	4.58	1.091 (.354)

** $p < .05$.
ANOVA, analysis of variance; NA, North American; TV, technology vision.

Table 7. ANOVA Test Results for Firm Control Variables

	Firm Control Variables					
	Firm Size			Resource Availability		
Constructs	Small Firms Mean ($n = 100$)	Large Firms Mean ($n = 100$)	ANOVA (Sig.)	Low RA Mean ($n = 109$)	High RA Mean ($n = 91$)	ANOVA (Sig.)
TV first-order dimensions						
F-1 TV benefits goal	4.70	4.26	3.160 (.077)*	4.33	4.67	1.894 (.170)
F-2 TV efficiency goal	4.74	4.34	3.193 (.075)*	4.42	4.69	1.451 (.230)
F-3 TV magnetism	5.42	5.30	.527 (.469)	5.38	5.33	.066 (.797)
F-4 TV specificity	5.35	5.37	.010 (.922)	5.20	5.54	3.622 (.058)*
F-5 TV infrastructure clarity	4.54	4.66	.433 (.511)	4.40	4.84	6.332 (.013)**
TV second-order construct	4.95	4.79	1.906 (.169)	4.75	5.02	5.186 (.024)**
Early performance outcome factors						
ESC early success with customers	5.03	5.12	.223 (.637)	4.96	5.21	1.834 (.177)
TCA technical competitive advantage	5.85	5.84	.006 (.938)	5.85	5.83	.021 (.885)
AAC ability to attract capital	4.73	4.75	.015 (.902)	4.72	4.77	.070 (.791)

* $p < .10$; ** $p < .05$.
ANOVA, analysis of variance; RA, resource availability; TV, technology vision.

specificity and TV infrastructure clarity. This said, firm-level control variables did not have a significant impact on TV as a second-order construct, nor did it have an impact on any of the early performance outcome factors. In terms of the competition-level control variables, as mentioned, *industry* had no impact whatsoever. *Country* did have an impact in terms of the TV efficiency goal, whereby NA firms had significantly higher levels of efficiency as a key goal for their TV. Again, competition-level control variables did not have significant impacts on TV overall, or on the EP factors. Interestingly, the one set of controls that did have an impact in terms of differentiating between performance factors was the technology-level control variables. Perhaps not surprisingly, higher levels of *patenting* as an appropriability strategy distinguished significantly between firms in terms of their TCA. In addition, firms with lower levels of *complexity* related to their technology had a better AAC. No other differences with the technology controls were found to be significant.

In order to better understand the significance of the impact of these two control variables, patenting and complexity, on early performance determination in relation to technology vision, further multiple regression tests were undertaken to assess their contribution to the overall EP

Table 8. ANOVA Test Results for Technology Control Variables

	Technology Control Variables					
	Patents			Complexity		
Constructs	Low Patent Mean ($n = 86$)	High Patent Mean ($n = 114$)	ANOVA (Sig.)	Low Complexity Mean ($n = 102$)	High Complexity Mean ($n = 98$)	ANOVA (Sig.)
TV first-order dimensions						
F-1 TV benefits goal	4.50	4.47	.020 (.886)	4.47	4.50	.011 (.917)
F-2 TV efficiency goal	4.50	4.58	.125 (.724)	4.70	4.38	2.089 (.150)
F-3 TV magnetism	5.23	5.45	1.711 (.192)	5.29	5.43	.660 (.417)
F-4 TV specificity	5.23	5.46	1.646 (.201)	5.46	5.25	1.421 (.235)
F-5 TV infrastructure	4.46	4.70	1.818 (.179)	4.57	4.63	.117 (.733)
TV second-order construct	4.78	4.93	1.484 (.225)	4.90	4.84	.276 (.600)
Early performance outcome factors						
ESC early success with customers	5.17	5.00	.783 (.377)	5.18	4.97	1.322 (.252)
TCA technical competitive advantage	5.58	6.04	13.762 (.000)**	5.85	5.83	.016 (.899)
AAC ability to attract capital	4.68	4.79	.336 (.563)	4.93	4.55	3.946 (.048)**

** $p < .05$.
ANOVA, analysis of variance; TV, technology vision.

Table 9. Standardized Regression Equation: TCA-Dependent, and TV- and Patent-Independent

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	*t*	Sig.
1	(Constant)	4.335	.403		10.746	.000
	UsingPatent	.077	.031	.169	2.466	.015
	TechnologyVision	.219	.073	.205	2.989	.003

TCA, technical competitive advantage; TV, technology vision.

equation. In the case of patenting, while it is of borderline significance in terms of contribution to TCA, it is the TV itself that has a higher and significant impact on TCA at both the .05 and .1 levels, as can be seen in Table 9. The standardized regression equation for the impact on TCA when both TV and patents are taken into account is as follows:

$$\text{TCA} = 4.335 + .205\ \text{TV} + .169\ \text{Patent}.$$

In the case of low levels of complexity, however, both low complexity and TV contribute significantly (at the .1 level) to AAC, with lower complexity appearing to have a slightly higher beta value, and therefore contributing slightly more to the AAC component of early performance, as illustrated in Table 10. The standardized regression equation for the impact on AAC when both TV and complexity are taken into account is

$$\text{AAC} = 4.352 - .135\ \text{complexity} + .120\ \text{TV}.$$

In sum, the relative impact of patenting compared with TV is slightly lower in the case of TCA, while the relative impact of lower complexity is slightly higher in the case of AAC.

Conclusions and Managerial Implications

This study contributes to research in the field of radical innovation and provides guidance to managers on several fronts. First, it was found that there is an important need for a technology vision, at the front end of radical innovation, in order to offer a sense of direction and focus for individuals during this critical early phase. This is particularly important at this stage of NPD, when many new products flounder because of a lack of direction. As such, technology vision is central to the successful development and commercialization of new products, in the case of technology-enabled radical innovation through the provision of a conceived potential trajectory from the onset.

In this paper, the components of what makes an excellent technology vision have been explored. Five significantly important components of technology vision have been found: goals related to benefits, goals related to efficiencies, clarity of vision with respect to infrastructure, specificity of the vision, and vision magnetism. The findings show that technology vision is positively related to all three early performance measures, defined as a better AAC (vital to reaching the next stage), providing an early TCA over competing products, and ESC. This shows that investors and customers are interested in the benefits and efficiencies provided by the technology separately from the potential impact they will have in the marketplace. Thus, securing an early TCA is inherently related to the way in which the technology is developed.

Firms need earlier measures of their performance, particularly in industrial sectors where products may take several years before their launch in the marketplace may be achieved. Developing a technology vision is important

Table 10. Standardized Regression Equation: AAC-Dependent, and TV and Complexity-Independent

Model		Coefficients[a]				
		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	*t*	Sig.
1	(Constant)	4.352	.625		6.959	.000
	Complexity	−.362	.187	−.135	−1.931	.055
	TechnologyVision	.191	.111	.120	1.715	.088

[a] Dependent variable: AAC.
AAC, ability to attract capital; TV, technology vision.

in terms of attracting potential investors and early customers. Early customers also need and want to have a sense of whether the overall focus of a technology's development is going to help them along one, or all, of the following dimensions: to solve a major problem; to create a major benefit; or to do something they have done in the past, but in a much less costly way. Having clarity of vision pertains to the technology infrastructure that the firm adopts early on. This may constrain choice, but on the positive side it provides a sense of direction in a world of seemingly infinite possibilities. This ultimately helps facilitate slower cash burn, hence improving cash flow in industries, which often require very high levels of resource commitments. Specificity of vision is helpful in providing specific direction within the broad guidelines of the technology infrastructure provided by a clear vision. Developing these two, infrastructure clarity and specificity of vision, comes from both successful past experiences and/or an intuitive sense of where a given technology is going. Contrary to popular belief, an intuitive sense is not irrational as intuition also evolves from experience and learning (Simon, 1987).

A firm's technological potential carries the promise for capitalizing on new opportunities, and the market and investors react to potential. This is precisely what technology vision and patents are able to deliver. What makes these findings interesting is the important distinction that while patents deliver a very clear technological potential, technology vision helps integrate the technological potential with a visionary's social capabilities and internal resources, which are required to be successful in the marketplace. As a result, in order to achieve true technological competitive advantage early on in the eyes of employees, potential investors, the marketplace, and other stakeholders, technology visioning is not only complementary to patenting, but in fact is required in order to be able to proceed along the product development trajectory. This was demonstrated by the other aspects of early performance, ESC, and AAC, which were impacted by TV, but were not impacted by patenting.

The findings of the study resonate with well-known examples of successful visions for new technologies. For example, Levy (2006) describes the story of Steve Jobs's return to power at Apple and his vision to take MP3 technology to the next level with the iPod. In terms of benefits goals, Jobs's vision was very clear in terms of creating a device that was extremely user friendly, easy to use, and convenient (the three aspects of user benefits found to be significant in this study). With Steve Jobs at the helm, there was no question that not only would the concept be clearly communicated to those working on the design and development, and that the infrastructure would be in place to get it out to the public as quickly as possible, but it was done in such a way that the vision for the technology was compelling, desirable, and attractive. This shows the importance of vision magnetism, and the important emotional commitment by key technology visionaries who inspire the whole development team and give them a sense of purpose and pride in their work. As such, the role of the technology visionary in terms of their ability to communicate the vision itself in a compelling way is also clearly important to the process.

Finally, technology vision is a complex phenomenon. Understanding the components of technology vision and its impact on early success were important objectives of this research. These objectives were successfully met, and by doing so a key gap in the theoretical literature has been filled. Importantly, an analysis of a "real-time" emergent industry in North America and the United Kingdom was provided together with practical outcomes for enhancing technology vision. Lastly, this research illuminates a path to an entirely new research agenda concerning technology vision.

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Appendix

Final Scale Items (I) to Measure Technology Vision

Benefits goal (alpha = .95)	The early functional goal of our technology development was about. . . . . . how to make things more convenient for customers and employees. (I1) . . . how to make things easier for our customers and employees. (I2) . . . how to make things more user friendly for customers and/or employees. (I3)
Efficiency goal (alpha = .73)	The early efficiency goal of our technology development was about. . . . . . how to most cheaply incorporate the technology into potential products. (I4) . . . how to apply the technology more cheaply than the competition. (I5) . . . how to solve the economics behind the science. (I6)
Magnetism (alpha = .80)	The goal of the technology was attractive. (I7) The goal of the technology was desirable. (I8) The goal of the technology was compelling. (I9)
Specificity (alpha = .89)	In the very early stages of this technology's development. . . . . .the technology vision was tangible (e.g., easy to visualize). (I10) . . .the technology vision was clear. (I11) . . .the technology vision was specific. (I12) . . .the technology vision was able to provide direction to others in the organization. (I13)
Infrastructure (alpha = .82)	In the very early stages of this technology's development, it was clear. . . . . .what facilities would be needed. (I14) . . .what human resources would be needed. (I15) . . .how much it would cost to develop. (I16)

Final Scale Items (I) to Measure Early Performance

Please indicate the degree of success, which you feel your company has achieved along each of the following indicators as a result of involvement with the technology (1 = 0%; 7 = 100%).

Early success with customers (ESC)	Early customers accepted the products stemming from the technology (even prior to sales). (I1) Early customers were satisfied (even prior to sales). (I2) Customers' needs were (will be) satisfied better by these products than existing ones. (I3)
Technical competitive advantage (TCA)	Innovation's technical quality. (I4) Innovation's value to the organization. (I5) Unique benefits: perceived as superior to competitors. (I6)
Ability to attract capital (AAC)	Average growth in company employment stemming from involvement with the technology. (I7) Cash flow. (I8) Ability to attract capital. (I9)