Information Systems Research

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

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To cite this article:
Sung-Byung Yang, Jee-Hae Lim, Wonseok Oh, Animesh Animesh, Alain Pinsonneault, (2012) Research Note—Using Real Options to Investigate the Market Value of Virtual World Businesses. Information Systems Research 23(3-part-2):1011-1029. http://dx.doi.org/10.1287/isre.1110.0397

Information Systems Research
Vol. 23, No. 3, Part 2 of 2, September 2012, pp. 1011–1029
ISSN 1047-7047 (print) | ISSN 1526-5536 (online)

http://dx.doi.org/10.1287/isre.1110.0397

Research Note

Using Real Options to Investigate the Market Value of Virtual World Businesses

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Virtual worlds are relatively nascent IT platforms with the potential to radically transform business processes and generate significant payoffs. However, in striving to achieve specific outcomes, firms may incur significant risks. Although many companies claim to have attained substantial benefits from their virtual world initiatives, many others have recently scaled down or even abandoned their experimental virtual world projects. This paper assesses the value proposition of virtual world initiatives from the real options perspective. Specifically, we argue that virtual worlds act as a firm's growth option, and we adopt the lens of real options to evaluate the value of this emerging and uncertain technological platform. We employ the event study method to assess the stock market's perception of the future revenue streams of 261 virtual world initiatives announced between 2006 and 2008. Our results indicate that, overall, the market reacts positively to virtual world initiatives. Our findings also show that investors' reactions to virtual world initiatives are contingent on four key characteristics of virtual world initiatives: interpretive flexibility (i.e., technologies that allow managers to experiment), divisibility (i.e., ability to incrementally implement the technology), strategic importance (i.e., an initiative that affects a process of strategic importance to the firm), and exploitable absorptive capacity (i.e., ability to exploit the knowledge acquired through the initiative). We discuss the key implications for real-world practitioners and suggest directions for future research.

Key words: virtual world investments; value creation; real options; strategic importance; divisibility; exploitative absorptive capacity; event study
History: Anitesh Barua, Senior Editor; Indranil Bradhan, Associate Editor. This paper was received on February 27, 2009, and was with the authors 16 months for 3 revisions. Published online in *Articles in Advance* February 13, 2012.

1. Introduction

Virtual worlds[1] (VWs) that once existed only in fiction and graphical simulation games have now become a real-life business proposition. From online advertising, to avatar-based shopping, to the exchange of virtual products and virtual currency for real money, VWs have the potential to transform our business horizons, refine existing business processes, and serve as an important source of consumers' emotional well-being (Castronova 2005). As of June 2010, Second Life (http://www.secondlife.com) had more than 16 million registered user accounts and generated $160 million in quarterly user-to-user sales (Linden 2010).

The rush into the artificial world is not limited to Internet powerhouses. Many traditional companies, such as Adidas/Reebok, BMW, Sony, Toyota, and Starwood Hotels (Siklos 2006), have made early

[1] Consistent with prior research (Bloomfield 2007), virtual worlds are broadly defined to include three types: (1) 3D virtual worlds (e.g., Second Life, There.com), (2) 2D or 3D social virtual worlds (e.g., Kaneva, Facebook, MySpace), and (3) massively multiplayer online games (e.g., Entropia Universe, Lineage).

forays into VWs as a means of revolutionizing their strategic campaigns. Major retailers and service agencies have purchased land in public VWs (e.g., Second Life) to open stores (e.g., Nike and Domino's), news agencies (e.g., CNN and Reuters), and brokerage services (e.g., Coldwell Banker and H&R Block). Furthermore, many high-tech firms (e.g., IBM, Xerox, Cisco Systems, Unilever) have transcended the public venues (e.g., Second Life and There.com) and constructed their own proprietary VWs in which they can effectively manage their global operations (King 2008). These companies recognized VWs' potential to radically transform the manner in which they develop, price, and promote their products and services (Hagel and Armstrong 1997). In addition, they seek to fully leverage the new digitized platform (i.e., infrastructures that allow a firm to broaden and/or enhance its repertoire of IT applications and services) to nurture innovation in customer relationships, forge collaborations with partners, and adapt other key business processes and activities.

However, some of these early adopters have already opted to "escape" from the VWs because they failed to recognize the expected value inherent to these new platforms. For example, BMW, a German automobile company, recently announced its withdrawal from Second Life after nearly two years of operation. Similarly, Google decided to terminate the VW project only three months following the launch of its own 3D VW prototype named Lively. As is seemingly apparent in these anecdotes, many firms view VW initiatives[2] as experiments that contain high uncertainty in achieving the desired outcomes and involve irreversible learning and adaptation costs (Fichman 2004). In the absence of well-proven best practices, firms tend to experiment with the VWs and decide whether or not to continue their investments in such platforms. Consequently, VW initiatives could be thought of as an *option*: firms can either fully implement or discontinue their ongoing pilot projects depending on the projected value generated by the underlying technologies.

Accordingly, we assess the business value of VWs through the lens of real options frameworks, which have been suggested as suitable mechanisms to evaluate the value of emerging, uncertain technological platforms (Kogut and Kulatilaka 1994, Fichman 2004, Bardhan et al. 2004). Specifically, drawing on Fichman's theoretical underpinnings of real options (2004), we identified five antecedents and articulated how each of these factors can affect the option value of VW investments. To empirically validate our research model, we employed the event study method, which is currently becoming widely used as a value assessment trajectory in management research (e.g., Dos Santos et al. 1993, Subramani and Walden 2001, Chatterjee et al. 2002, Dehning et al. 2003, Anderson et al. 2006, Rangathan and Brown 2006). This instrument is particularly well suited to determine the business value and future revenue streams of uncertain, emerging IT platforms, such as VWs, because it collectively captures both the risk and return aspects of the event (Dewan and Ren 2007). Kumar (2005) adopted the event study method to assess the real option value of joint ventures.

This study offers several contributions to both the research and practitioner communities. In terms of the research contribution, we apply the real options framework to assess the value of emerging, uncertain IT platforms. Drawing on Fichman's value creation view of real options (2004), we provide a conceptual foundation for understanding the value creation trajectories related to VW platforms. Furthermore, we conduct an empirical study to validate the viability of Fichman's real options perspective in the contexts of VWs. Although the real options approach has become increasingly popular as a theoretical framework in IT valuation research (Tallon et al. 2002), there is a paucity of existing research that empirically tests such conceptual frameworks. Therefore, our conceptual extension and empirical validation provide researchers and practitioners with a formalized understanding of the business value associated with nascent VW platforms. In terms of practical contributions, our findings provide the constituents of VWs significant insights into the strategic opportunities and challenges that may arise from their participation in VW initiatives. Our findings also offer companies initial guidance and prescription regarding what factors, among those suggested by Fichman (2004), are particularly crucial in generating benefits from VW investments.

The remainder of the paper is structured as follows: the next section presents the theoretical background and hypotheses, §3 describes the research method, and §4 presents the results of our study. The implications of the paper for research and practice are discussed in §5, and §6 concludes by discussing the limitations of the study and directions for future research.

2. Theoretical Backgrounds and Hypotheses Development

2.1. A Real Options Perspective on Virtual World Platforms' Value

There is a growing stream of literature that adopts real options theory to examine the economic value

[2] In this paper, the term "virtual world initiatives" refers to a broad set of initiatives related to virtual social networks (based on either 2D or 3D technology) that allow participants to interact, transact, socialize, collaborate, communicate, and/or create their own virtual space to express themselves.

of various types of IT investments, including ERP (Taudes et al. 2000), decision support systems (Kumar 1999), telecommunication infrastructure (Panayi and Trigeorgis 1998), and ATM banking infrastructure (Benaroch and Kauffman 1999). Researchers often suggest that firm executives are confronted with two types of challenges when determining information technology (IT) platform investments: (1) uncertainty regarding the extent of their potential benefits and (2) irreversibility with respect to the cost of initiating and deploying the underlying technologies (Fichman 2004). Because the real options approach (ROA) provides executives with managerial flexibility, it is touted as an effective valuation mechanism for IT platforms that tend to exhibit high uncertainty and irreversibility (Trigeorgis 1993).

High uncertainty surrounding VW platforms exists with respect to their inability to provide users with stable services and to generate sustainable profits for the investing firms. For example, VW platforms typically necessitate powerful computing resources because they operate in a highly interactive and graphical environment (e.g., 3D backgrounds and avatars). Consequently, users are often discouraged from utilizing such infrastructures because of frequent technical disruptions and unstable services (Biocca 2000). This type of technological uncertainty leading to user resistance may pose a great challenge to businesses when they elect to utilize VW platforms to facilitate their commercial transactions. Furthermore, although VWs may be revolutionary, many business experts remain skeptical about the future sustainability of VW ventures, many of which drive profits primarily by transacting virtual items (e.g., virtual clothes, furniture, house, land) through the exchange of virtual currencies. Such experts claim that this type of trendy market is likely to reach its saturation stage prematurely as users quickly tire of virtual transactions and lose interest in paying real money for virtual goods (Gupta and Han 2008). In fact, both Cyworld and Mixi (major VW ventures in Korea and Japan, respectively) have been experiencing a sharp decrease in their growth rates for virtual item sales.

Finally, there is also a significant concern about the health risks associated with repeated viewing of multidimensional graphics. A recent Internet survey in the United States showed that 25% of American viewers complained of eye fatigue, nausea, dizziness, and headaches after being repeatedly exposed to stereoscopic 3D images and movies (SciLifestyle 2011). Moreover, Samsung and Sony, two leading pioneers of 3D TV technologies, warned the public about possible negative health effects of such technological manifestations (Simpson 2010). If VW platforms indeed turn out to be "good for business, but bad for health," companies that invested in this technology may have no other option than to terminate their ongoing VW operations. Thus, VW platforms operate with high uncertainty that arises from potential user resistance, a lack of solid business sustainability, and potential health-related hazards.

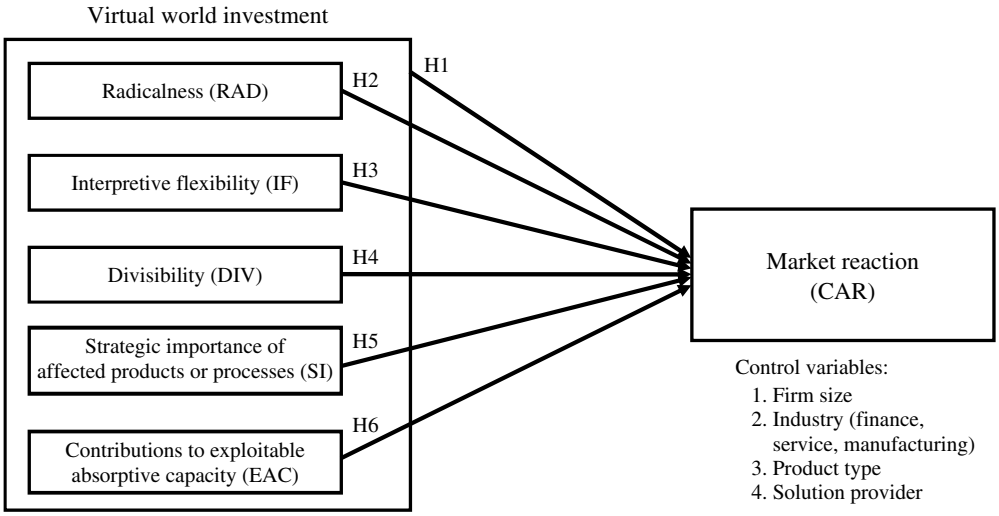
Although the future benefits associated with VW platforms are uncertain, the investment expenditures committed to the development of such infrastructures are irreversible and sunk costs the investing firms cannot readily disinvest. Pindyck (1988, p. 969) stated that "[i]rreversibility usually arises because capital is industry- or firm-specific, that is, it cannot be used in a different industry or by a different firm." VW platforms are highly firm specific because they are developed to improve a firm's unique strategic capabilities or operational processes. For example, VW-generated work flows, employee training facilities, real estate showrooms, proprietary virtual toys, private advertisements, and promotions are all highly firm-specific resources that are germane to a firm's idiosyncratic processes, unique products, and services. Therefore, they cannot be readily used for other purposes.

Because of VWs' high uncertainty and irreversibility, managers are encouraged to undertake proprietary VW initiatives through a multiphase implementation process by which they initially draft pilot projects or prototypes and later convert them into full-fledged projects. Consequently, such multistaged implementation approaches create "growth" options[3] for the investing parties (Kogut and Kulatilaka 1994, Fichman 2004). In this respect, investments in VW initiatives can be conceptualized as growth options because they create a platform to generate follow-up investment opportunities, which may subsequently influence a firm's strategic position. The VW-related resources—capabilities and assets—that are developed or acquired by the firm provide a bundle of options for future strategic choices. For example, a firm using VWs to enhance its customer process capabilities may decide, based on the success of its initial investment in VWs, to exploit its VW experience and the platform to develop its strategic and/or operational process capabilities. Thus, investments in VW iniatives can create significant growth opportunities at the expense of high uncertainty in ascertaining the payoffs.

2.1.1. Determinants of Real Options' Value. For conceptual foundations, we drew upon Fichman's two-stage value creation framework for real options (Fichman 2004). In this framework, Fichman initially identified several categories of determinants that may

[3] Growth options refer to a situation where early investment is a "prerequisite or a link in a chain of interrelated projects, opening up future growth opportunities" (Trigeorgis 1993, p. 204).

Figure 1 VWs' Value Creation: A Real Options View



affect the value of real options, including technology strategy, organizational learning, innovation bandwagons, and technology adaptation. Based on these perspectives, Fichman further extracted a dozen specific antecedents associated with the value of emerging IT platforms (see Fichman 2004, p. 138). These determinants are then evaluated through the lens of "intermediate mechanisms," which denote specific measures of real option value, such as expected value of payoffs, variance of payoffs, or flexibility.[4] Finally, a real option's value is determined by a combination of these intermediate variables. Regarding the specific value creation trajectory, Fichman stated that "a determinant will be considered to increase option value if it tends to increase the expected value of potential returns, increase the variance of potential returns, or increase managerial flexibility in the structuring/exercise of options" (2004, p. 140).

Although all 12 factors Fichman (2004) identified are important for determining real options' value, in the present study we focused primarily on five factors for conceptual extensions and empirical assessments.[5] These five determinants include *radicalness*, *interpretive flexibility*, *divisibility*, *strategic importance of affected products or processes*, and *contributions to exploitable absorptive capacity* (see Figure 1). The first three factors are associated with the characteristics of a technology context, whereas the remaining two determinants indicate the characteristics of the organizational context (Fichman 2004). In what follows, we assess the overall business value of VW platforms and articulate how each of these aforementioned five antecedents may impact the valuation of VW platforms.

2.2. The Value of VWs

From a growth option perspective, VW platforms can enable firms to build digital capabilities, exploit new opportunities, and leverage significant strategic and operational advantages (Animesh et al. 2011). For example, through VWs, firms can enhance the understanding of their consumers' profile and product/service preferences by observing consumers' social networks, their activities and behavior, and their interactions with one another as well as with the VW platform. Barnes & Noble, for example, has introduced My B&N VW where consumers can create their literary identity, connect and share insights with one another, and discover or evaluate new products. A firm can employ VWs to engage consumers in codeveloping products, obtain customer feedback, and test product ideas, which in turn contributes to the innovation initiatives by building and fostering virtual consumer communities. PepsiCo Inc., for instance, has launched Dewmocracy, a virtual world that allows consumers to join in developing the next generation of products, which may result in a consumer-generated beverage innovation.

Moreover, VWs can allow firms to enable greater interfirm collaboration with its partners. For example, Ingram Micro Inc. has announced The Zone, a new virtual social network designed to make it easier for solution providers to partner and communicate with fellow members within a specific Ingram Micro supply chain network. VW initiatives also provide a firm with an opportunity to forge new partnerships and thus increase its ability to explore and exploit innovation opportunities. Recently, Research In Motion (RIM), for example, has teamed up with

[4] These factors are all positively associated with the value of real options. See Fichman (2004) for detailed explanation regarding how each affects the value of real options.

[5] We provided the explanation for excluding some of the Fichman's constructs in the limitations section.

MySpace to develop a new mobile social portal for BlackBerry smartphones, enabling millions of BlackBerry users to leverage MySpace on the go and access content, friend networks, and status and mood updates anywhere at any time. Finally, VW platforms can also be used to digitize various business processes, lowering operational costs and allowing more informed decision making. For example, Manpower Inc. has refined its business process by launching the Manpower Island in Second Life, where job seekers, employers, and entrepreneurs can come together, share ideas, and identify new opportunities. IBM has created a "rehearsal studio" that enables employees to practice their jobs and client interactions in a simulated VW.

Because this new technological platform provides firms with an opportunity to promote active customer involvement and participation, forge new strategic partnerships, and improve operational efficiency, investment in VW initiatives can be seen as indicative of a firm's strong commitment to improving future earnings and shareholders' value. Therefore, we posit the following.

Hypothesis 1 (H1). *The market will react positively to VW initiatives announced by a firm.*

2.3. Determinants of VW Platforms' Option Value

Although the announcements of VW initiatives are generally expected to produce positive market returns, there may be variability among firms depending on several attributes of the real options that these initiatives enable. In this section, we focus on specific factors that may impact the value of the real options, which are embedded in the VW platform investments. Drawing on the value creation view of real options (Fichman 2004), we examine how the five unique characteristics of VW platforms affect the market value of their VW initiatives. The factors related to technology characteristics are discussed first and then the determinants pertaining to organizational characteristics are presented.

2.3.1. Technology Characteristics

Radicalness. The major distinction between radical and incremental innovations in organizational contexts has frequently been understood in terms of the magnitude of transformation in conjunction with work processes, product or service development, or technology implementation (Dewar and Dutton 1986). For example, radical innovation revolutionarily alters the current practices, whereas incremental innovation keeps the foundation of such organizational routines and merely seeks minor improvements or adjustments. Yet there are a variety of innovations that may fall somewhere in the midrange of this continuum. Fichman (2004, p. 141) defines radicalness as "the extent of potential improvements in organizational products or processes enabled by the technology platform." Although both types of innovation have been explored conceptually primarily through case studies, there is a paucity of research available that empirically compares, utilizing a large-scale data set, the outcomes resulting from these two types of innovation (Dewar and Dutton 1986). Insights emerging from such research have revealed that the effect of radical innovation, when successful, can be paradigm breaking, positively rewarding, and long-lasting, as evidenced by several radical technological innovations (e.g., telephones, word processors, celluloid-film cameras; see Utterback 1994). However, this positive effect seems to tell only one side of the story. Typically, high risks are also inherent to radical innovation because the revolutionary change could completely redesign the many aspects of organizational operations, including those that were positively conducive to firm performance.

Fichman (2004, p. 141) noted, "The effects of radicalness on the expected value of returns from innovation is unclear because the potentially greater returns are offset by correspondingly greater expenses." This statement suggests that identifying the net effect of radical innovation may be complicated. However, he claimed that radical IT platforms could increase the variances in potential payoffs because uncertainty abounds in planning and implementing such technological infrastructures. Consequently, in certain contexts the high level of uncertainty inherent to radical IT platforms can increase the value of real options for such platforms.

VW environments may provide one such context in which radical IT platforms are able to generate higher real option values than are incremental IT platforms. Because of the high uncertainty involved in the development and operation of VWs, the outcomes of radical VW platforms are likely to be more volatile than those of incremental VW counterparts. Accordingly, in light of real option theory (e.g., McGrath 1997), the option value for radical VW platforms increases because potential positive returns from such operations are immense, and potential losses can be limited to the costs associated with developing the prototype. For example, Mattel (http://www.mattel.com/), a popular toy manufacturer, has recently launched a VW platform (http://www.barbiegirls.com/) where girls can create their personalized avatars, design their own private rooms, and hang out and chat live with other girls. Departing from its traditional, physical toy-selling business, the company, through this VW platform, offers everything a girl could want. Girls can earn B Bucks (i.e., a form of cyber money) and shop at the B Chic Boutique (i.e., a virtual toy store with 3D effects), B Stylin' Shop (i.e., a beauty

shop), or B Charmed Accessories and Furni Fever stores (i.e., a virtual accessory and furniture shop) or meet up with friends at the B Cafe™ (i.e., a virtual cafe). Chuck Scothon, a senior vice president at Mattel, stated,

> We set out to create a platform that is truly revolutionary to transform how girls interact with music, fashion and the online world. Barbie Girls™ is the result of listening to what girls want, researching how they play and fusing it with the right technology to deliver a completely new experience. (Scothon 2007)

The company further announced that upon success of this initial operation, it will launch the second phase of Barbie Girls™, (i.e., a virtual world) as well as the Barbie Girl™ device (i.e., a techy, doll-inspired MP3 player with a range of customizable fashions and accessories) to innovate the ways girls experience the fashion and music services.

In view of Fichman's notion of radicalness, this VW platform, on one hand, could revolutionarily improve the company's existing organizational products and service processes while substantially diversifying its revenue sources and creating a springboard for growth. On the other hand, uncertainty looms because the business relying heavily on virtual items has recently declined. Furthermore, because young children are the majority of VW business clients, the potential health-related concern arising from repeated viewing of 3D environments could jeopardize its outlook. Yet the multistaged operation could keep the potential loss to a minimum, and returns from this revolutionary transformation could be substantial. Therefore, uncertainty surrounding radical VW platforms can increase the expected variance of payoffs (Fichman 2004), leading to a higher value of real options than in incremental VW platforms. Consequently, we posit the following.

Hypothesis 2 (H2). *The market will react more positively to the announcements involved with radical VW platforms than to those related to incremental VW platforms.*

Interpretive Flexibility. Despite a torrent of both conceptual and empirical studies, the issues pertaining to the specific role, function, and use of technology in organizations have continued to perplex information systems (IS) researchers. To shed some light on this issue, Orlikowski (1992) introduced a dualistic view in which technology can be thought of as either a deterministic and fixed object or a by-product of human and social interaction that is contextually embedded in organizations and institutions. The latter view suggests that social and institutional factors stimulate users to interpret, appropriate, and manipulate technology in diverse ways (see Orlikowski 1992, p. 408, for the detailed illustration of this view). This relates to the notion of interpretive flexibility defined as "the degree to which users of a technology are engaged in its constitution (physically and/or socially) during development or use" (Orlikowski 1992, p. 409). Drawing upon this perspective, Fichman (2004) postulated that the extent to which technology can be interpretively flexible[6] is positively associated with the value of real options. The rationale is that technology with high interpretive flexibility empowers managers to experiment with a large, diverse set of implementation configurations, which substantially increases managerial flexibility with respect to the adoption and appropriation of current and future technologies.

Interpretive flexibility is an essential precondition for the full utilization of VW platforms and their benefits (tangible and intangible). For example, in 2008, IBM introduced a VW platform dubbed a "rehearsal studio" where employees could rehearse their job duties and practice interacting with clients. Initially, this facility appeared to serve as an artifact that provided a simple job training service. However, although it started as an isolated professional job training center, the rehearsal studio later morphed into a comprehensive, dynamic social and knowledge forum where employees from various parts of the world meet, socialize, and engage in intellectual exchanges. This transition and expansion was possible because employees, as users of the technology, were able to interpret, appropriate, and manipulate the underlying VW platform in such a way that created both tangible (e.g., reduction in communication costs) and intangible (e.g., advanced knowledge sharing and improved coordination through both professional and social interactions) benefits. In contrast, VW platforms that are low in interpretive flexibility, such as those established to carry out specific tasks at a given time and space (e.g., temporal advertising), may have a limited capacity to offer such diverse interpretations. Therefore, we posit the following.

Hypothesis 3 (H3). *The market will react more positively to announcements involving VW initiatives with high interpretive flexibility than to those that are low in interpretive flexibility.*

Divisibility. Defined as "the extent to which a technology can be divided for sequential implementation in such a way that each incremental segment positions the firm for a positive payoff" (Fichman 2004, p. 139), divisibility is the central concept in the application of option theory to the quantitative evaluation of nonfinancial investments (Bowman

[6] Fichman (2004) defined interpretive flexibility as "the extent to which a technology permits multiple interpretations on the part of adopters about how it should be implemented and used" (p. 139).

and Hurry 1993). By utilizing the sequential planning and implementation efforts of strategic investment portfolios, firms can more flexibly identify and harness growth opportunities while navigating challenges with great caution. Further, this sequential approach enables companies not only to reduce the risk of failure but also to increase the chance of success in managing an assortment of investment portfolios with "step-by-step" experiments. At each stage or segment of the technology implementation, firms can determine whether to continue with or abandon the current platform and which new platform to adopt if an adjustment is necessary. This experimental approach is possible for many IT projects because they are, by nature, interdependent and broken into phases (Bardhan et al. 2004). More importantly, firms can systematically accumulate both tacit and implicit knowledge through the sequential implementation and utilize past experience to generate positive returns for future IT investments. In this sense, managerial flexibility and knowledge accumulation increase the value of options.

The sequential implementation approach is particularly effective for building and managing VW initiatives because one VW platform often serves as a seed from which another can sprout, while each complements the other to create business synergies. For example, in 2007, Disney Online, part of the Walt Disney Internet Group, initiated the Virtual Reality Studio, which specialized in graphical engineering and virtual reality technologies. A few months later, Disney acquired Club Penguin, one of the most popular portal sites for children, in pursuit of entering the VW businesses and building and expanding its online communities. The company also launched the highly interactive broadband platform that integrates online games, video, and community elements. These prototypes, although implemented sequentially, have all contributed to the successful introduction of a series of Disney's VW platforms such as Toontown Online (http://www.toontown.com), Pirates of the Caribbean Online (http://www.piratesonline.com), and Disney.com XD (http://www.disney.com/xd).

Recently, Disney decided to create a new corporate division, Disney Online Studios, in which the key initiators of these previous successful platforms joined together to establish a comprehensive, integrated VW platform that ultimately offers a plethora of VW services and products. Paul Yanover, a company executive vice president, indicated an even further expansion plan, stating, "In addition to the existing resources, there will also be a significant expansion of the development, community, operations and publishing teams to more fully address growing opportunities in the online games and community space" (Yanover 2008). As evident in this anecdote, the degree to which technology can be divided and implemented sequentially is important for VW platforms' ability to generate maximum returns. Therefore, we posit the following.

Hypothesis 4 (H4). *The market will react more positively to VW initiatives that can be implemented sequentially than to those that cannot be divided into sequential segments.*

2.3.2. Organizational Characteristics

Strategic Importance of Affected Products or Processes. Previous IS event studies have consistently revealed that the market reacts more favorably to announcements related to strategic IT initiatives than to those of nonstrategic (e.g., operational) IT initiatives (Dos Santos et al. 1993, Chatterjee et al. 2002, Dehning et al. 2003, Anderson et al. 2006). This finding suggests that competitive advantages created through IT investments could be short lived and difficult to sustain over a long time period unless such investments are an integral part of a firm's key competitive actions involving new products and processes (Subramani and Walden 2001, Dehning et al. 2003, Anderson et al. 2006).

Fichman (2004, p. 139) defined the *strategic importance of affected products or processes* as "the extent to which the products or processes potentially improved by the innovation are central to the competitive position or value proposition of the firm." Many of the VW initiatives have strategic implications because they often enable firms to refine current business processes and initiate the development of new services and/or products (Barnes 2007). From a value creation point of view, VW initiatives with greater strategic implications may create higher levels of competitive advantages than do those that have less strategic significance.

Such competitive advantages would then be translated into an increase in the expected value of net payoffs. For example, RIM's strategic partnership with MySpace would enable the smartphone developer to capitalize on the power of social networks to expand the company's market penetration while simultaneously exploiting new revenue-generating opportunities by innovating services and products. In contrast to these strategic actions, a considerable number of companies merely join the bandwagon to implement VW initiatives that are short term, small scale, or event driven. One telecom company, for instance, has purchased land in Second Life for temporary promotional events with less strategic intent. Although such events are operationally important, these temporary actions are likely to have a limited impact on firms' competitive positions and future earnings. Consequently, less significant abnormal market returns can

be expected following the announcement of such VW initiatives.

In addition, the magnitude of strategic investments with respect to VWs would also be positively associated with variance in net payoffs. Organizations with a repertoire of strategic initiatives tend to effectively detect and respond to a variety of environmental changes and exploit an array of follow-up projects (Benaroch and Kauffman 1999). Yet the risk might also increase because such strategic initiatives involving new products and processes require additional resources and commitments (Fichman 2004). Because of this broadened scope of growth opportunities, the variance of net payoffs for VW initiatives with greater strategic ramifications can be expected to increase, thus leading to a higher option value. Therefore, we posit the following.

Hypothesis 5 (H5). *The market will react more positively to announcements involving VW initiatives that affect a firm's competitive position than to those related to VW initiatives that do not.*

Contributions to Exploitable Absorptive Capacity. Absorptive capacity, which denotes a firm's ability to exploit external knowledge critical to innovation (Cohen and Levinthal 1990, Pavlou and El Sawy 2006), has occupied the central attention of organizational theorists for nearly two decades, providing theoretical building blocks for research on organizational learning and knowledge management. From a real options perspective, exploitable absorptive capacities (EACs), defined as "the extent to which knowledge to be gained during deployment contributes to absorptive capacity in domains with long-lasting strategic relevance" (Fichman 2004, p. 139), increase a firm's capability to effectively scan the environment, detect and seize new opportunities, and utilize outside knowledge. Fichman (2004) postulates that the more a firm accumulates EACs, the higher the level of managerial flexibility to undertake future projects and handle follow-up investments, hence the larger the value of real options.

We argue that firms with abundant EACs are more likely to succeed in VW platform initiatives than are firms with limited EACs because the former can more effectively sense and capitalize on the market opportunities enabled by emerging VW technologies than the latter can. Given the premature nature of VW commercial fronts and the lack of solid, proven profit models, it is imperative for firms to identify new opportunities and to develop strong value creation trajectories for competitive action. This suggests that EACs may serve as such valuable strategic assets critical to a firm's success in VW operations. Firms with sufficient EACs are in a better position than are those with limited EACs when it comes to obtaining market intelligence and recognizing new opportunities surrounding VW platforms. Therefore, thanks to their ability to utilize outside knowledge, firms rich in EACs can exploit "entrepreneurial alertness"[7] (Sambamurthy et al. 2003) by effectively sensing the dynamic market environment. Such firms can also accomplish this by making informed decisions regarding whether to exercise their options and when to implement their VW operation. Therefore, we posit the following.

Hypothesis 6 (H6). *The market will react more positively to VW initiatives announced by firms with sufficient exploitable absorptive capacities than by those with limited exploitable absorptive capacities.*

3. Methods

3.1. Data

To collect VW-related announcements, we adopted procedures and mechanisms similar to those employed in previous event studies (e.g., Dos Santos et al. 1993). Using the most representative keyword (i.e., virtual world), we performed a full-text search in the LexisNexis database that compiles daily major newspapers, wire services, and other business publications. Based on our identification of such announcements, we assessed the patterns of word usage in the media related to VW businesses and developed a broader set of search terms accordingly (Ranganathan and Brown 2006). Our expanded set of keywords includes terms such as *virtual world*, *virtual environment*, *virtual space*, *social network*, and their variants. In addition, the keyword list contains the names of leading VW service providers (e.g., Second Life, There.com, Habbo Hotel, MySpace, Facebook) and a set of action verbs (e.g., *launch*, *announce*, *invest*, *partner*). Armed with these terms and phrases, we performed an exhaustive search of articles covering a three-year period from January 1, 2006, to December 31, 2008. Such an in-depth search is necessary to maximize the identification of the relevant articles. Following these comprehensive procedures, we identified 10,987 articles.[8]

After reading each article carefully, we removed 10,503 announcements containing management staff changes (e.g., hiring or retiring of executives), generic news on VWs that did not mention firm-specific events, and other events irrelevant to VW businesses. Through this filtering process, we identified

[7] Entrepreneurial alertness is "the capability of a firm to explore its marketplace, detect areas of marketplace ignorance, and determine opportunities for action" (Sambamurthy et al. 2003, p. 250).

[8] Dos Santos et al. (1993) found 97 events from initial identification of more than 4,500 articles on possible IT investment announcements. We found 261 relevant events from 10,987 initial articles.

484 announcements directly related to VW businesses. However, 223 of these 484 announcements were excluded in the final sample for various reasons. Specifically, we found and eliminated 71 duplicated announcements (e.g., two articles containing the same or similar news). We also removed another 55 announcements because the events pertained to private companies. Moreover, we excluded 85 announcements because of potential confounding effects (i.e., announcements of other major events, such as earnings announcements, mergers, and acquisitions that also occurred around the release date of information about the VW businesses). Finally, 11 announcements were also omitted because stock information was unavailable in the Center for Research in Security Prices (CRSP) database. A subsequent cross-match with the Global Vantage Key (GVKey) file from COMPUSTAT resulted in the elimination of one additional firm, which was not covered by the database. The final sample for this study, therefore, consists of 261 announcements (see panel A of Table 1 for the step-by-step data collection procedure).

3.2. Distribution of Sample

Panel B in Table 1 summarizes the industry distribution of the 261 firms according to their two-digit Standard Industrial Classification (SIC) codes. The 261 samples cover six industry groups. Among them, the service industry has the highest number of firms with VW announcements (34.9%), followed by the transportation and communications industry (27.6%). The remainder of the sample was drawn from the machinery, electronic, and other equipment (18.4%) and wholesale trade and retail trade (7.7%) industries. The smallest number of firms falls into the finance, insurance, and real estate (5.7%) and construction and manufacturing (5.7%) industries.

3.3. Measures

The dependent variable in this study is *cumulative abnormal returns* (*CARs*), which reflect the investors' perception of the event being announced over the two-day period (day −1 and day 0). The use of this two-day event window has been highly recommended by McWilliams and Siegel (1997). A detailed description of the *CARs*, including its conceptual derivation and computational procedures, is provided in the next section. To account for the variations in the outcomes of the *CARs*, we regressed the five independent variables (*radicalness*, *interpretive flexibility*, *divisibility*, *strategic importance of affected products or processes*, and *contribution to exploitable absorptive capacity*) on the *CARs*. To operationalize these independent variables, we either conducted a content analysis of VW announcements based on the coding scheme described below or obtained the secondary data (e.g., COMPUSTAT) as proxies for the corresponding construct. Note that we adopted Fichman's definitions to operationalize all of our independent variables. Descriptions and measurements of all variables are summarized in panel C of Table 1. In addition, a detailed coding scheme and a sample set of announcements are provided in the online appendix.[9]

3.3.1. Radicalness (*RAD*)**.** In compliance with Fichman's (2004) definition, announcements were categorized as having *high radicalness* if the adopted VW platform is expected to (1) replace, rather than build on, existing technologies (Henderson 1993); (2) revolutionarily improve the company's existing organizational products or service processes; or (3) have wide-ranging effects on the structure of businesses or the industries to which they belong by substantially altering their revenue sources or creating immense growth opportunities. Conversely, announcements with limited potential improvements were coded as having *low radicalness*.

3.3.2. Interpretive Flexibility (*IF*)**.** Building on the notion of adaptive structuration theory (DeSanctis and Poole 1994), Fichman (2004, p. 147) stated that "interpretive flexibility allows organizations greater discretion in how they choose to appropriate a technology and adapt it over time." This suggests that technology ownership significantly influences the extent of interpretive flexibility. A proprietary VW platform can allow the owner firm to have high degrees of freedom and "laissez-faire" in terms of designing and implementing platform-related features, policies, and rules. In contrast, users of nonproprietary platforms (e.g., Second Life) are typically obligated to meet the specific requirements (e.g., design, functionality, and commercial restrictions) set by the regulating parties; hence only limited discretion can be exercised with respect to the platform selection and adoption. Based on this rationale, we coded VW initiatives as having *high interpretive flexibility* if they were established through private platforms and having *low interpretive flexibility* if otherwise.

3.3.3. Divisibility (*DIV*)**.** In accordance with Fichman's (2004) definition, VW platforms were coded as having *high divisibility* if one of the following conditions was met: (1) such platforms were established and implemented sequentially (e.g., one process must be completed before another is initiated), (2) developers indicated that they performed experiments (e.g., prototypes) prior to the full implementation, or (3) management expressed further expansion plans. In contrast, announcements that did not meet any of these conditions were coded as having *low divisibility*.

[9] An electronic companion to this paper is available as part of the online version at http://dx.doi.org/10.1287/isre.1110.0397.

Table 1 Sample Analysis

A: Restrictions leading to final sample

Steps	Description	Sample
Step 1	Initial sample (via LexisNexis) using a set of keyword searches	10,987
Step 2	Less:	(10,503)
	—Articles that contain generic news on VWs without mentioning firm-specific events	
	—Articles that contain either financial performance announcements (e.g., earnings, dividend payments) or management staff changes (hiring or retiring of executives)	
	—Articles that contain events irrelevant to VW businesses	
Step 3	Less: duplicate announcements	(71)
	Less: announcements by private firms	(55)
	Less: announcements influenced by other company news (e.g., dividends, earnings, mergers or acquisitions, board changes)	(85)
	Less: announcements missing CRSP data	(11)
	Less: announcements missing COMPUSTAT data	(1)
Final sample size		261

B: Industry composition

Two-digit SIC code	Industry	No.	%
20, 23–25, 27–28	Construction and manufacturing	15	5.7
35–39	Machinery, electronic, and other equipment	48	18.4
44, 47–49	Transportation and communications	72	27.6
50, 53, 56, 58, 59	Wholesale trade and retail trade	20	7.7
60–63, 65, 67	Finance, insurance, and real estate	15	5.7
70, 72–73, 78–79, 99	Service	91	34.9
Total		261	100

C: Variable descriptions

Variable name	Description	Measurements
$CARs_i$	The average standardized cumulative abnormal returns for firm i over day −1 and day 0 (Dos Santos et al. 1993, Im et al. 2001). For more detailed discussion of analytical techniques employed in event studies, see Loderer and Mauer (1992) and McWilliams and Siegel (1997).	$CARs_i$
Radicalness (*RAD*)	VW platforms can replace, rather than build on, existing technologies (Henderson 1993) and can have wide-ranging effects (both intended and unintended) on the structure of businesses or even entire industries; otherwise, radicalness will be coded as low.	0 = low radicalness 1 = high radicalness
Interpretive flexibility (*IF*)	VW initiatives use proprietary platforms or nonproprietary platforms (e.g., Second Life, Facebook) (Aggarwal et al. 2006).	0 = nonproprietary platform 1 = proprietary platform
Divisibility (*DIV*)	VW initiatives use VW-related technologies that can be divided and implemented sequentially; otherwise, divisibility will be coded as low.	0 = low divisibility 1 = high divisibility
Strategic importance (*SI*)	Whether the firm announcing VW initiatives can have long-term strategic impact on the core business products and processes of the firm (e.g., changing the competitive position or value proposition; see Porter 2001); otherwise, strategic importance will be coded as low.	0 = low strategic importance 1 = high strategic importance
Exploitable absorptive capacity (*EAC*)	The extent of the firm's exploitable absorptive capacity. Research and development expenditure as a percentage of sales was computed and then adjusted with respect to the industry median (Balakrishnan et al. 1996, Dehning et al. 2007).	$(R\&D_{firm}/\text{Net Sales}_{firm}) - (R\&D_{ind.\ median}/\text{Net Sales}_{ind.\ median})$
Size (*SIZE*)	Natural log-transformed Total Assets_{t-1} (COMPUSTAT: AT) (Dehning et al. 2003, Cheng 2005).	LNTA_{t-1}
Finance (*FNC*)	1 if the firm is a member of the finance industry (SIC codes are between 6000 and 6999), 0 otherwise (Im et al. 2001, Chatterjee et al. 2002).	0 = nonfinance industry 1 = finance industry
Service (*SVC*)	1 if the firm is a member of the service industry (two-digit SIC codes are between 70 and 89), 0 otherwise (Im et al. 2001, Chatterjee et al. 2002, Ranganathan and Brown 2006).	0 = nonservice industry 1 = service industry
Manufacturing (*MFC*)	1 if the firm is a member of the manufacturing industry (two-digit SIC codes are between 20–38, but excluding SIC 3573), 0 otherwise (Dos Santos et al. 1993).	0 = nonmanufacturing industry 1 = manufacturing industry
Product (*PRD*)	Whether the firm announcing VW initiatives produces digital products or tangible products (Subramani and Walden 2001).	0 = digital products 1 = tangible products
Solution provider (*SP*)	Whether the firm announcing VW initiatives provides VW-related IT solutions or uses them (Chatterjee et al. 2002).	0 = non-solution provider 1 = solution provider

3.3.4. Strategic Importance of Affected Products or Processes (*SI*)**.** Announcements with substantial strategic implications to a particular firm were coded as having *high strategic importance*, whereas those with only operational significance were coded as *low strategic importance*. More specifically, announcements with long-term strategic impact on a firm's core business products and processes (e.g., changing the competitive position or value proposition; see Porter 2001) were coded as *high strategic importance* and *low strategic importance* if otherwise. For example, if a company merely joined the bandwagon to implement VW initiatives that were short term, small scale, or event driven, then strategic importance was considered low. However, if the organizational intention of the firm was to strategically use the VW platform as a marketing channel to eventually either replace or complement existing channels, then such initiatives were considered high on strategic importance.

3.3.5. Contributions to Exploitable Absorptive Capacity (*EAC*)**.** We also employed the secondary data to represent the extent of a firm's *EAC*. According to Cohen and Levinthal (1990), firms that fully manage their own research and development (R&D) are better able to utilize externally available information. Therefore, absorptive capacity may be created as a by-product of a firm's R&D investment. As a proxy for a firm's extent of *EAC*, the R&D expenditure was measured as a percentage of sales. However, to obtain a more accurate measure, we adjusted this ratio with respect to the industry median (Balakrishnan et al. 1996, Dehning et al. 2007). Specifically, the following formula was utilized:

$$EAC = (\mathrm{R\&D}_{\mathrm{firm}}/\mathrm{Net\ Sales}_{\mathrm{firm}}) - (\mathrm{R\&D}_{\mathrm{industry\ median}}/\mathrm{Net\ Sales}_{\mathrm{industry\ median}}).$$

3.3.6. Coding Procedures. Given that a coder's subjectivity may hinder his or her ability to accurately assess the news announcements, it is critical that a systematic coding procedure be properly designed and implemented. To ensure the accuracy and reliability of coding results, we adopted the Joshi et al. (2010) coding procedures. First, based on Fichman's (2004) conceptualization, we developed a prototype for the coding scheme by applying it in the VW context. During this process, we also drew upon some criteria employed by other studies (e.g., Henderson 1993, Porter 2001) to refine the initial coding scheme. Second, it is often challenging to provide coders a priori with an exhaustive list of criteria by which to identify whether a specific case falls into either a high or a low category (e.g., determining whether a given technology is radical or not). Therefore, we conducted a pilot coding test based on the initial coding scheme. For example, 20% of the total 261 VW announcements were randomly selected and completely analyzed by the two authors of this paper. Disagreements between coders were discussed until consensus was reached. This process led to further refinement of the coding scheme. Third, two authors each read all of the articles selected for the final sample and performed the coding task individually on the basis of the refined binary scheme.[10] When the two coders rated a VW announcement differently, such discrepancies were again reconciled through discussions, which in turn led to greater fidelity of the coding scheme. Finally, to cross validate the coding results, all announcements were independently coded by an external judge who had considerable VW experience and expertise. This expert was provided with the construct definitions (as defined by Fichman 2004) along with a complete coding scheme and several sample announcements for each construct. Then the expert was asked to read each of the announcements and assign a binary code for each of the constructs. The interrater reliability between this expert's coding and our coding was tested using Cohen's kappa coefficient (Cohen 1960): the results show 90%, 92%, 87%, and 77% for the *RAD*, *IF*, *DIV*, and *SI* variables, respectively. These reliability scores are well above the recommended threshold of 70% (Cohen 1960), and all exceed those reported by Chatterjee et al. (2001) (e.g., 80%–82%) and Dehning et al. (2003) (e.g., 83%), with the exception of the *SI* variable (77%). Following these detailed coding processes, the observed disagreements were jointly reexamined and reconciled through discussions.

3.3.7. Control Variables. To attenuate their potential effects on the results, we identified several control variables by reviewing previous IT-valuation event studies and included them in the model. We controlled for firm size (*SIZE*) by utilizing the natural logarithm of one-year prior total assets (Dehning et al. 2003, Cheng 2005). Similarly, industry effects were controlled by including dummy codes representing finance (*FNC*) (Im et al. 2001, Chatterjee et al. 2002), service (*SVC*) (Im et al. 2001, Chatterjee et al. 2002, Ranganathan and Brown 2006), and manufacturing (*MFC*) (Dos Santos et al. 1993) industries. In addition, similar to Subramani and Walden (2001), a variable representing product type (e.g., tangible or digital products) was also added to the model to isolate its potential impact. Finally, following the approach of Chatterjee et al. (2002), we included a dichotomous control variable that denotes whether the corresponding firm is an IT solution provider or IT solution user.

[10] In many of previous IS event studies, the authors were directly involved in data coding (e.g., Dos Santos et al. 1993, Dehning et al. 2003, Aggarwal et al. 2006).

3.4. Market Model

Event study methodology calculates excess or abnormal returns on an event date, relative to a market-wide return. Expected market adjusted returns for a particular date depend intuitively on estimated systematic risk and the overall stock price movement. Given stock market value increases or decreases over the course of each day, the market-adjusted event return measures the expected price movement of one stock type within its estimated parameters. With overall market movements, the difference between the expected change and the actual change during the event period, called the abnormal return, reflects the return in excess of the normal return.

CARs indicate the extent to which shareholders adjust their beliefs about a firm's value because of recent events.[11] Positive CARs are likely to occur when most shareholders perceive that the new event will result in significant future cash flows. In contrast, negative CARs occur when shareholders hold pessimistic views regarding the impact of the event on future cash flows. With respect to the methods for computing CARs, we followed the conventional procedures employed in previous IT event studies (e.g., Dos Santos et al. 1993, Subramani and Walden 2001, Chatterjee et al. 2002, Dehning et al. 2003, Anderson et al. 2006, Ranganathan and Brown 2006, Dewan and Ren 2007):

$$R_{it} = \acute{a}_i + \hat{a}_i R_{mt} + \dot{a}_{it}, \tag{1}$$

where

R_{it} = The daily return firm i at time t,
R_{mt} = The equally weighted market return from the CRSP index at time t,[12]
$\acute{a}_i$ & $\hat{a}_i$ = The market model parameters for firm i,
$\dot{a}_{it}$ = The disturbance (error) term.

Using the parameter values estimated from Equation (1), abnormal returns (ARs) are next constructed for each firm (i) during the event window (t) as

$$AR_{it} = R_{it} - (\acute{a}_i + \hat{a}_i R_{mt}), \tag{2}$$

where

AR_{it} = Abnormal return of ith firm for time period t,
R_{it} = Actual return of ith firm for time period t.

[11] Based on commonly used accounting and finance literature, daily common stock returns are described by the market model, based on the capital asset pricing model (CAPM).

[12] There are two commonly used market indices: (1) the equally weighted index and (2) the value-weighted index. Following the recommendation of Dann and Mikkelson (1984), we use the equally weighted index, which is more likely to detect abnormal security returns.

The two-day excess return for the sample of N firms is calculated over days -1 and 0, where -1 is the day before the announcement, and day 0 is the day of the announcement. This yields CARs as

$$CAR = \frac{1}{N}\sum_{i=1}^{N} CAR_i,$$

where

$$CAR_i = \sum_{i=-1}^{0} AR_{it}. \tag{3}$$

To test whether abnormal returns over the event period are significantly different from zero, we computed the standardized abnormal return (SAR) for firm i on event day t as

$$SAR_{it} = AR_{it}/SD_{it}, \tag{4}$$

where

$$SD_{it} = \left\{ S_i^2 \times \left[1 + (1/T)(R_{mt} - R_m)^2 \Big/ \sum_{t=-201}^{-2} (R_{mt} - R_m)^2 \right] \right\}^{\frac{1}{2}},$$

AR_{it} = Abnormal return of ith firm for time period t,
Si^2 = The residual variance from the market model over the estimation period,
T = The number of days in the estimation interval,
R_m = The mean return on the market index over the estimation period.

To statistically validate the significance of the CARs around the event date, we followed the procedures used in previous event studies (e.g., Dos Santos et al. 1993, Im et al. 2001, Chatterjee et al. 2002, Dehning et al. 2003, Anderson et al. 2006, Ranganathan and Brown 2006, Dewan and Ren 2007) where the cumulative standardized abnormal return (CSAR) for each firm over the time interval defined by (t_1, t_2) is calculated as

$$CSAR_i = \sum_{t=t_1}^{t_2} \frac{SAR_{it}}{\sqrt{t_2 - t_1 + 1}}. \tag{5}$$

To assess the statistical significance of the average effect of the event on the market value of the N firms, the Z-statistic is defined as

$$Z = \frac{1}{\sqrt{N}}\sum_{i=1}^{n} CSAR_i. \tag{6}$$

For more detailed discussion of analytical techniques employed in event studies, see Loderer and Mauer (1992) and McWilliams and Siegel (1997).

3.5. Cross-Sectional Regression Analysis

We conducted a regression analysis (see Equation (7)) of the two-day CAR as the dependent variable

(Dos Santos et al. 1993, Im et al. 2001) and the five types of VW initiatives corresponding to H2–H6 (plus an intercept term) as the independent variables (see panel C of Table 1 for variable descriptions). Finally, based on previous studies, we also included six control variables to control for the possible effects of firm and industry characteristics on the outcomes:

$$CAR_i = \beta_0 + \beta_1 RAD + \beta_2 IF + \beta_3 DIV + \beta_4 SI + \beta_5 EAC + \beta_6 SIZE + \beta_7 FNC + \beta_8 SVC + \beta_9 MFC + \beta_{10} PRD + \beta_{11} SP + \varepsilon_i. \quad (7)$$

4. Results

Table 2 shows the CAR for various trading days and windows, ranging from two days before to two days after the announcement. The results suggest that investors react positively to VW announcements, which is illustrated by the CAR (a mean of + 0.459%, $p < 0.05$).[13] Consequently, H1 was supported. The magnitude (+0.459%) was greater than those found in some of the major IT event studies (e.g., 0.09% in Dos Santos et al. 1993, 0.02% in Im et al. 2001, and 0.38% in Oh et al. 2006). However, this CAR is smaller than those reported in the Chatterjee et al. (2001) and Ranganathan and Brown (2006) event studies (0.88% and 0.83%, respectively). Because of the broad heterogeneity inherent in IT investments (e.g., types of IT investments, timing of announcements), a direct comparison of the CARs should be interpreted with caution.[14] The positive and negative CARs were symmetrically distributed: 128 announcements (49%) produced a positive reaction, whereas 133 others (51%) resulted in a negative one.[15] This symmetric frequency distribution suggests that investors are more likely to react to specific details of VW announcements than to actual announcements (Oh et al. 2006).

Table 2 **The Average Standardized Cumulative Abnormal Returns ($N = 261$)**

Window	Sample size	(Pos:Neg)	Mean (%)	Std. dev.	*Z*
(0, 1)	261	(131:130)	0.451	0.045	1.599
(−1, 0)	261	(128:133)	0.459	0.036	2.031**
(−1, 1)	261	(136:125)	0.659	0.050	2.108**
(−2, 2)	261	(143:118)	0.908	0.056	2.554**

*, **, ***Significant at the 0.10, 0.05, and 0.01 levels, respectively (two-tailed tests of significance).

Table 3 **Descriptive Statistics**

Two-day (−1, 0) event window (full sample: $N = 261$)				
Variables	Min	Max	Mean	Std dev
CAR_i	−0.108	0.108	0.004	0.033
RAD	0 ($N = 104$)	1 ($N = 157$)	0.602	0.491
IF	0 ($N = 113$)	1 ($N = 148$)	0.567	0.496
DIV	0 ($N = 91$)	1 ($N = 170$)	0.651	0.477
SI	0 ($N = 142$)	1 ($N = 119$)	0.456	0.499
EAC	0.000	0.619	0.052	0.085
SIZE	1.241	14.672	9.288	2.542
FNC	0 ($N = 246$)	1 ($N = 15$)	0.057	0.233
SVC	0 ($N = 170$)	1 ($N = 91$)	0.349	0.477
MFC	0 ($N = 246$)	1 ($N = 15$)	0.057	0.233
PRD	0 ($N = 205$)	1 ($N = 56$)	0.215	0.411
SP	0 ($N = 248$)	1 ($N = 13$)	0.050	0.218

Note. Contextual characteristics are defined in panel C of Table 1.

Descriptive statistics for all of the variables included in the analysis are shown in Table 3. From a total of 261 samples, 157 (60%) were identified as highly radical VW initiatives, whereas 104 (40%) were categorized as low radical. As for the types of VW platforms, 57% of the announcements were concerned with highly interpretive flexibility, whereas 43% were associated with low interpretive flexibility. The majority of the VW initiatives were related to high divisibility (65%), whereas 35% dealt with low divisibility. In addition, 119 (46%) announcements were identified as having high strategic importance, whereas 142 (54%) were categorized as having low strategic importance.

Table 4 represents the correlation coefficients for all of the variables included in the multivariate model. None of the correlations were above 0.415, and the highest variance inflation factor (VIF) in our regression was 1.468, which is well below the

[13] We present our results for the shorter window (−1, 0) because it is more likely to accurately reflect the information content of the VW announcement itself. To check the robustness of the result to changes in the event windows, we also replicated our results for other multiday event windows (e.g., (0, 1), (−1, 1), and (−2, 2)) and found that most results remained significant at the 5% level (see Table 2).

[14] Considering whether VW initiatives might be leaked in advance of the actual event, we also checked the results for other event windows (e.g., (−3, −2), (−3, −1), and (−2, −1)). Interestingly, the event window (−2, −1) showed stronger market reactions (+0.548%) than the (−1, 0) event window. This result suggests that an information leakage might have occurred one or two days prior to the announcements of VW initiatives. Because investors have incentive to benefit from private information, there may be upward price pressure on the stock prior to the event. This is not an uncommon situation in the financial market. For example, Keown and Pinkerton (1981) documented that positive abnormal returns occur during the period prior to the initial merger announcement, showing that the average target firm earned a 13% abnormal return during the two-month preannouncement period. It is possible that preannouncement run-up is because of information regarding the target firm's stand-alone value. However, our results suggest that the preannouncement run-up may be because of public information leakage regarding the stand-alone value of the firm.

[15] With the exception of the event window (−1, 0), all other multiday windows exhibit more positive than negative reactions in relation to VW announcements, although the difference was marginal (see Table 2).

Table 4 **Correlation Matrix** ($N = 261$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) CAR_i	1											
(2) *RAD*	0.085	1										
(3) *IF*	0.153**	0.300***	1									
(4) *DIV*	0.116*	−0.021	−0.071	1								
(5) *SI*	0.173***	0.415***	0.225***	−0.008	1							
(6) *EAC*	0.144**	−0.061	0.132**	0.120*	0.006	1						
(7) *SIZE*	−0.059	−0.075	−0.190***	0.027	−0.086	−0.112*	1					
(8) *FNC*	−0.126**	−0.034	−0.017	−0.130**	0.038	0.007	−0.025	1				
(9) *SVC*	0.008	−0.045	−0.010	0.164***	0.057	0.067	−0.220***	−0.181***	1			
(10) *MFC*	−0.126**	−0.102	−0.017	−0.061	−0.127**	−0.048	−0.106*	−0.061	−0.181***	1		
(11) *PRD*	0.089	−0.051	−0.071	−0.244***	−0.104*	−0.111*	−0.056	−0.009	−0.265***	0.232***	1	
(12) *SP*	−0.096	−0.065	−0.084	0.168***	−0.174***	0.005	−0.068	−0.057	0.054	−0.057	−0.120*	1

*, **, ***Significant at the 0.10, 0.05, and 0.01 levels, respectively (two-tailed tests of significance).

suggested multicollinearity problem threshold of 10 (Marquardt 1980). We examined the standard errors and size of the coefficients and found that they were sensitive neither to the inclusion nor to the exclusion of the highly correlated variables, indicating that multicollinearity is unlikely to be present (Hosmer and Lemeshow 1989). The results show that the dependent variable (*CAR*) was positively correlated with the variables that measure *IF* (0.153, $p < 0.05$), *DIV* (0.116, $p < 0.10$), *SI* (0.173, $p < 0.01$), and *EAC* (0.144, $p < 0.05$).

4.1. Cross-Sectional Regression Results

Table 5 reports a summary of the regression results for the overall model shown in Equation (7). It should be noted that the model is effective in explaining the *CARs*, with significant model *F*-statistics ($F = 3.611$, $p < 0.01$) and adjusted *R*-squares of 9.9%.

Table 5 **Results of Regression Analysis** ($N = 261$)

	Unstandardized coefficients	Std. error	Standardized coefficients (beta)	*t*
Constant	0.010	0.010		0.954
RAD	−0.001	0.005	−0.021	−0.318
IF	0.008	0.004	0.114	1.768*
DIV	0.010	0.004	0.148	2.364**
SI	0.009	0.004	0.144	2.151**
EAC	0.078	0.039	0.120	1.976**
SIZE	−0.001	0.001	−0.043	−0.669
FNC	−0.019	0.009	−0.134	−2.193**
SVC	−0.003	0.005	−0.044	−0.664
MFC	−0.022	0.009	−0.158	−2.524**
PRD	−0.014	0.005	−0.172	−2.642***
SP	−0.013	0.009	−0.085	−1.375
F-value	3.611***			
Adjusted *R*-square	9.9%			

Notes. Variable descriptions are defined in panel C in Table 1. Dependent variable: CAR_i.

*, **, ***Significant at the 0.10, 0.05 and 0.01 levels, respectively (two-tailed tests of significance).

This adjusted R^2 (9.9%) was greater than those found in most of the previous IS event studies, including 3.3% in Dehning et al. (2003), 4.0% in Oh et al. (2006), 4.3% in Chatterjee et al. (2001), and 8.5% in Ranganathan and Brown (2006).

The OLS results indicate that four out of five independent variables—*IF* ($\beta = 0.114$, $p < 0.10$), *DIV* ($\beta = 0.148$, $p < 0.05$), *SI* ($\beta = 0.144$, $p < 0.05$), and *EAC* ($\beta = 0.120$, $p < 0.05$)—were significantly associated with the *CAR*, although *RAD* was not found to be significant. Therefore, H4–H6 were strongly supported, but there was only marginal support for H3 (*IF*) at the 10% level. Among the various control variables included in the analysis, *FNC* ($p < 0.05$), *MFC* ($p < 0.05$), and *PRD* ($p < 0.01$) were significantly related to the *CAR*.[16] Table 6 summarizes all of the hypothesis test results.

5. Discussion and Implications

Academics and practitioners both assert that VW platforms have the potential to generate considerable benefits for the businesses that embrace them (Au 2009, *Economist* 2010a). However, there is a lack of comprehensive research that assesses and quantifies the value created by firms' VW initiatives. Although firms recognize the potential of VWs to improve strategic actions and facilitate interactions with customers and partners, the biggest challenge faced by the majority of businesses is understanding and justifying the value proposition of their VW initiatives because the benefits are often "soft" or intangible (*Economist* 2010b). Drawing upon Fichman's real options perspective, we sought to shed some light on this issue

[16] We also ran the multiple regression analysis by including the VW type variable (coded as 0 if the announcement involved 3D VWs (e.g., Second Life, There.com) and 1 if the announcement was related to virtual social worlds (e.g., Facebook, MySpace)). However, the relationship between VW type and the *CAR* was not found to be significant.

Table 6 Summary of the Results

Hypothesis	Main constructs	Hypothesis testing	Key findings
H1	Market value of virtual worlds	Supported	VW investments lead to significant positive returns for investors.
H2	Radicalness (*RAD*)	Not supported	VW initiatives' radicalness does not directly impact a firm's value creation.
H3	Interpretive flexibility (*IF*)	Marginally supported	Shareholders reward virtual world initiatives that have higher interpretive flexibility with higher returns.
H4	Divisibility (*DIV*)	Supported	The degree to which VW initiatives can be divided and implemented sequentially influences the market's perception positively.
H5	Strategic importance of affected products and processes (*SI*)	Supported	Investors react positively to VW initiatives that affect a firm's competitive position.
H6	Contributions to exploitable absorptive capacity (*EAC*)	Supported	Shareholders perceive the great potential of VW initiatives that are initiated by firms with sufficient exploitable absorptive capacities.

by examining the value of investments in VW platforms and identifying factors that impact such initiatives' valuation. Our findings suggest that VW investments lead to significant positive returns for investors, demonstrating that the business value of VWs is real, even when the benefits are intangible and returns on investments are not readily visible. The financial market recognizes the full potential of VWs as legitimate commercial venues through which many real-world business transactions can occur.

Although the results show that overall the market favors initiatives involving VWs, we found that not all VW investments are created equal, as far as value creation is concerned. Investors' reactions vary substantially depending on several characteristics of the VW initiatives. Specifically, among the five determinants extracted from Fichman's value creation framework, *interpretive flexibility associated with the VW platform* (*IF*), *the divisibility of the VW initiative* (*DIV*), *strategic importance of VW initiative to the affected products or processes within the company* (*SI*), and *exploitable absorptive capacity of the firm* (*EAC*) were all found to be significantly associated with the *CAR*, although *IF* was marginally significant at the 90% confidence level. As hypothesized, results suggest that a firm can enhance its valuation by investing in VW initiatives that impact its core strategy, planning the initiative so as to increase the divisibility and interpretive flexibility of technology and fostering its absorptive capacity.

However, according to our findings, the VW initiative's high radicalness (*RAD*) did not affect a firm's value. There are two potential explanations for why VW initiatives' radicalness does not impact a firm's value creation. First, as articulated by Fichman (2004), potentially high returns that result from radical VW initiatives can be offset by substantial tangible and intangible expenses associated with radical VW development and maintenance, including complementary changes to organizational structures and policies. For instance, McDermott and O'Connor (2002) found that radical innovations led to competency stretching where resources (e.g., technological, managerial, knowledge, financial) were extended into new directions or ventures, which entailed significant market and technological risks. Consequently, this finding supports Fichman's (2004) conjecture in that the mixture of "hopes and worries" surrounding radical VW initiatives manifests in the minds of investors in the market. Second, radical VWs can generate substantial expected returns, but possibly at the expense of reduced managerial flexibilities. Radical changes often trigger disruptions and discontinuities in organizations and compel them to consume slack resources (e.g., resources in excess of what is required) to ease the transition (Ettlie 1983). These buffer resources serve as key elements of managerial flexibility (Bourgeois 1981). Therefore, in view of slack resources, increased benefits from radical VW initiatives can be offset by reduced managerial flexibility; hence, the mixed market reaction occurs. Future research needs to investigate the validity of these explanations.

The study has various managerial implications. Because the VW initiatives with greater strategic importance are more valuable, we suggest that managers should focus their efforts on creating a VW platform that can support a broad range of strategies and enable a chain of growth opportunities rather than implementing ad hoc VW projects with a narrow focus on short-term objectives. For example, using a VW as a channel to conduct a one-time event to promote a brand may result in short-term gains. However, exploiting the platform in a way that enables long-term relationships with customers as well as elicits their input in the product development and marketing processes will be more valuable and sustainable.

Further, because we found that initiatives that have interpretive flexibility associated with the VW platform (*IF*) result in more positive abnormal returns, we suggest that firms should invest in VWs in which they have strong control over the platforms. We argue that public VWs offer less interpretive flexibility vis-à-vis a private VW, and our findings demonstrated

that announcements involving private VWs are more valuable. In addition to providing more control and flexibility, self-developing IT-enabled systems rather than using public systems[17] signals a firm's sincere commitment toward the project. Such actions also herald to the public that the system in question will become an integral part of the firm, significantly affecting the way in which business is conducted within that particular organization. One additional explanation for this result is that the systems developed in-house might be more agile, flexible, and secure than the publicly available systems. In fact, this result is consistent with the findings of previous IS event studies (see Oh et al. 2006 for a summary of past results), which suggested that the market favors announcements of proprietary IT investments (e.g., investments in IT infrastructure, proprietary e-commerce initiatives, private IT standards) and does not favor announcements of nonproprietary IT investments (e.g., IT outsourcing,[18] buying applications, open standards). Managers should take this into consideration when they contemplate launching new VW initiatives. However, we note that to succeed, proprietary IT system developments might require additional resources (e.g., financial and human resources, time) and organizational commitments. Future studies should investigate other factors that may influence the impact of proprietary VW platforms on the value creation.

One of the key aspects of a growth option such as investing in VW platforms is that the system can be structured as a series of follow-up projects to take advantage of the asymmetric nature of the positive and negative payoffs. Because a manager can avoid implementing the future follow-up projects in case the updated payoffs turn out to be negative at a later time, increased "incrementalism" enhances managerial flexibility and makes higher payoff variability more attractive. It lowers exit barriers and therefore provides managers with more options. Thus, managers should strive to make the VW initiative highly divisible such that each incremental project allows the firm to take advantage of a positive payoff even if no further implementation segments are pursued. Finally, firms should invest in building exploitable absorptive capacity to ensure the firm's effective utilization of the external information related to a variety of innovations including VW platforms.

[17] Note that utilizing public virtual worlds (e.g., Second Life) still requires a large investment for business enterprises.

[18] Several IS event studies show positive market reactions to announcements of IT outsourcing. However, apart from Loh and Venkatraman (1992), which is the first study that examined, using the Kodak effect, the market perception of IT outsourcing, most studies of this type have reported a small magnitude of CARs.

Apart from these practical implications, this paper has several pertinent theoretical implications as well. To the best of our knowledge, this is one of the first studies to employ a real options perspective to examine the value of VWs for actual businesses. The use of the event study methodology is a viable mechanism to examine the value of real options created by technology (Kumar 2005). Because of the difficulty of measuring the value as well as the risk of the real options created by technology, most of the studies adopting a real options lens to examine the value of IT investments either do not provide empirical evidence (Kumar 1999) or are limited to specific projects that make various assumptions regarding the real option parameters to calculate the relevant value (Benaroch and Kauffman 1999). Our approach provides a feasible strategy for researchers to empirically assess the impact of various technologies and other factors on the value of the real option embedded in technology investments.

6. Limitations and Future Research

Our study has several limitations. First, we provided empirical insights into only five of the 12 determinants Fichman explored conceptually. However, it is important to note that our choice of the research context (e.g., VW) inherently controls for most of the excluded constructs. For instance, we excluded the three factors related to "innovation bandwagons" (i.e., susceptibility to network externalities, prospects for network dominance—class, and prospects for network dominance—instance) because VW platforms in general exhibit extremely strong bandwagon effects (i.e., network externality; see Castronova 2005). Our sample has limited variability in terms of the potential or susceptibility for network effects (after taking into account the magnitude of the effect and the variability in the predictions of network effects' strength across different VW platforms in the initial phase). Because "susceptibility to network externalities" would be comparable for the majority of the cases in our study, we excluded this factor. Further, we are not comparing the prospect of network dominance across diverse technologies (e.g., spreadsheets, ATM networks, Web servers, electronic telephone switches), and our data sample only includes the VW technology class. Therefore, the "prospects for network dominance—class" construct does not vary substantially in our data sample. We also precluded "prospects for network dominance—instance" because although there are several instances of VW technology in our sample, the range of error for predicting the network effects' potential (assessed at the time of initiating such a project) would make the comparison more or less irrelevant. Furthermore, two factors ("sustainability of

advantage" and "knowledge barrier") were not considered for similar reasons. Because our analysis is based on the same technology, the level of sustainability of advantage and knowledge barrier is likely to be similar across the firms in our sample.

Finally, two other constructs related to organizational endowment ("innovative capabilities/endowments" and "learning-related endowment") were omitted because our data did not allow us to measure these organization-specific constructs, especially those that require us to identify either the availability or acquisition of VW technology-related knowledge capital in the organization before, during, or after deployment. Future studies should consider validating those factors that were unexplored by this research in order to completely test Fichman's (2004) value creation framework. In addition, we tested Fichman's model in the context of VW investments only. Therefore, our findings by no means can be fully generalized to other types of IT investments.

Second, the announcements included in the sample are voluntarily disclosed by large firms. As such, the sample is biased in the sense that it reflects the actions of particular firms (i.e., large firms) that do not represent the overall population. All event studies have this limitation and our study is no exception. In fact, we have found that many small- and medium-sized companies actively adopt VW initiatives as well. Future research should look into the strategic adoption of VWs initiated by organizations of every size and from all industries. Finally, given the paucity of research conducted regarding VWs, there are many intriguing and potentially fruitful avenues to explore. Although this study focuses on the value creation aspect of VWs, studies that survey the behavioral, social, and legal aspects of VWs are also important to foster an understanding of the mechanisms and driving forces under which VWs operate and evolve. What social or behavioral factors influence a consumer's intent to purchase? What social governance mechanisms can be used to effectively regulate the dynamics and interactions in VWs? What legal protections are necessary to facilitate the exchange of virtual goods? These are some of the questions that should be addressed by future research.

In conclusion, from a real options perspective, we explored the market's perception of VW platforms in relation to their ability to generate future benefit streams and increase shareholders' well-being. Although it is too premature to predict whether VW businesses will mirror the success of e-commerce companies in the 1990s, the market has a positive outlook for this emerging, IT-enabled world. Yet one principle does not change and perhaps never will: to generate cash flow, and thus elicit a favorable market reaction, IT-related initiatives must exist as an integral part of the firm's strategic configuration, whether deployed in the real or virtual world. Similarly, regardless of which world a business targets, managerial flexibility and growth opportunities play an important role in a firm's value creation. The exploration of VWs has just begun, and more innovative and transformational business ideas will be fused into this new venue.

Electronic Companion

An electronic companion to this paper is available as part of the online version at http://dx.doi.org/10.1287/isre.1110.0397.

Acknowledgments

W. Oh is the corresponding author of the paper. The authors would like to thank the senior editor (Anitesh Barua), the associate editor, and the anonymous referees for their constructive suggestions and comments on earlier versions of this manuscript. Thanks are also due to Minwoo Lee for his research assistance. S. B. Yang's current affiliation is the School of Business Administration, Ajou University, Korea. This research was partially funded by Fonds de Recherchesur la Société et la Culture (FQRSC) du Québec, the Social Sciences and Humanities Research Council of Canada, and Hansung University.

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