Follow the Pack or Make an Independent Decision? How Environmental Turbulence Affects ICT Sourcing Decisions

Completed Research Paper

Immanuel Pahlke
Frankfurt University
Grüneburgplatz 1
60323 Frankfurt, Germany
pahlke@wiwi.uni-frankfurt.de

Roman Beck
Frankfurt University
Grüneburgplatz 1
60323 Frankfurt, Germany
rbeck@wiwi.uni-frankfurt.de

Jens Vykoukal
Frankfurt University
Grüneburgplatz 1
60323 Frankfurt, Germany
jvykoukal@wiwi.uni-frankfurt.de

Abstract

Since market and environmental conditions are becoming increasingly turbulent, ICT sourcing alternatives (such as colocation) have gained considerable attention in the industry since they allow firms to become more agile and responsive to environmental changes and increasing competition. However, little research has been conducted to analyze how different factors affect ICT sourcing decisions in the light of uncertainty arising from environmental turbulence. Since uncertainty and unpredictability of environmental changes might lead to mimicry of successful business strategies, this article focuses on the analysis of how uncertainty resulting from environmental turbulence leads to an imitative ICT adoption behavior of firms. Based on a multi-method research approach, we applied a Delphi study and a quantitative field study. The empirical results support our hypothesis that turbulent environmental conditions lead to mimetic adoption behavior, thus providing a theoretical contribution to the extant literature.

Keywords: ICT, environmental uncertainty, institutional theory, top management

Introduction

Firms are increasingly engaged in competitive dynamics that are enabled or induced by information and communication technology (ICT) (Pavlou and El Sawy 2010). In particular, as the environment becomes more turbulent, firms increasingly regard ICT innovations as a means to become more agile and responsive to environmental changes (Sambamurthy et al. 2003). Competitive advantage in hypercompetitive environments is largely based on business activities that are performed better, faster, and more efficiently compared to competitors (D'Aveni 1994). However, the turbulent environment firms are facing – due to globalization of markets, high rates of technological progress, and increased inter-connectedness among disparate environmental elements – entails various problems for firms resulting from managerial misjudgments and poor decisions (D'Aveni 1994). According to the bounded rationality perspective, these misjudgments can be attributed to the limitations of human decision-making determined by (1) cognitive capabilities, (2) the amount of accessible information, and (3) the limited time period for decision-making (Simon 1959). Especially the last two aspects can often be attributed to environmental conditions of uncertainty and unpredictability (Pavlou and El Sawy 2006). However, the existing IS assimilation and adoption literature mostly disregards these influence factors. For example, although the organizational post-implementation phase of different innovations has been extensively researched in the extant IS literature (Zhu et al. 2006), little empirical research has been conducted on the interplay of rational factors driving innovation assimilation (Liang et al. 2007; Teo et al. 2003) and uncertainty arising from environmental turbulence (Pavlou and El Sawy 2006, 2010). The neglect of these issues in existing research models can be traced back to the implicitly underlying assumption of rational decision-making in firms that has served as the paradigmatic foundation. According to the principles of behavioral economics (e.g., Kahneman 2003), the paradigm's assumptions of rational behavior (Coleman and Fararo 1992) are not suitable to analyze strategic decisions of firms in turbulent environments. The focus of this article is placed on ICT sourcing decisions of firms that increasingly require fast access to communication and data networks and a reliable ICT infrastructure to stay competitive (Weill and Broadbent 1998; Weill et al. 2002). In particular, the ability to react quickly to market developments is of central importance for firms operating in highly dynamic and competitive markets (Sambamurthy et al. 2003) and requires them to purchase ICT infrastructure services from external providers which themselves benefit from economies of scale and scope (Lacity and Willcocks 1998). Hence, we base our work on the following research question:

How does uncertainty arising from turbulent environmental conditions affect imitative ICT sourcing decisions of firms?

Driven by this research question, our study seeks to improve the understanding of factors that affect the decision of top management to (further) support ICT sourcing practices in turbulent as well as in stable markets. As will be shown in the following sections, we developed a theoretical model based on a synthesis of two theoretical perspectives: the diffusion of innovation theory (Rogers 1995), that emphasizes the specific characteristics of an innovation (e.g., business strategy or technology), and the institutional theory (DiMaggio and Powell 1983) that focuses on the environmental context of firms. According to the new institutional theory, a central proposition of our work is that uncertainty which results from environmental turbulence leads to organizational isomorphism. In general, institutional theory posits that organizational survival is determined by the extent of alignment with the institutional environment and hence, firms have to comply with external institutional pressures (Kostova et al. 2008). Since we are dealing with a highly relevant but relatively under-researched topic, we adopted a multi-method approach to develop and validate a parsimonious research model used to provide an answer to our research question.

The paper is organized as follows. The next section provides an introduction to a special form of ICT infrastructure sourcing that is known as "colocation" and served as the subject of our study. Thereafter, we provide a review of relevant research streams and develop the theoretical foundation for our research model that consists of several hypotheses that are introduced subsequently. Finally, the methodology applied to test and validate the research model is presented and the results of the model validation are discussed. The last section concludes the paper by discussing the results of the data analysis and by illustrating the theoretical and practical contributions of our research results.

Colocation as an ICT Sourcing Strategy

The ability to react quickly to market developments is gaining importance for various business models (Sambamurthy et al. 2003). Hence, in turbulent or dynamic markets, firms often purchase ICT infrastructure services (e.g., preconfigured IT systems for standard applications) from external providers which themselves benefit from economies of scale and scope (Lacity and Willcocks 1998). However, the hosting of extensive and complex enterprise application systems is limited by coordination challenges and information asymmetries (Chiles and McMackin 1996). A relatively new sourcing alternative is the installation and operation of own ICT systems in external premises, which is known as ICT colocation, ICT hotel, or ICT housing. In contrast to shared services or captive centers that are wholly owned subsidiaries that provide ICT services to the parent firm (Oshri 2011), ICT colocation can be regarded as a form of co-sourcing which describes a combination of insourcing and outsourcing where an external vendor provides resources as an extension of the client's resources (Bergeron 2003). In particular, ICT colocation allows firms to outsource basic data center services to specialized colocation service providers which operate data centers that provide space (e.g., for server racks), high-speed Internet bandwidth, reliable power supply, sophisticated cooling systems, and fire extinguishing solutions. In contrast to hosting data centers, in which the hosting providers are responsible for management, operation, and administration of the ICT systems, colocation data centers enable customers to build up, manage, and operate their own ICT systems. Colocation facilities are attractive for several reasons, e.g., due to the availability and concentration of different network carriers, Wide-Area-Network (WAN) providers, and Internet service providers (ISPs) that physically cross-connect their ICT networks within such colocation centers to exchange data traffic without incurring data transfer fees. The accumulation of different service providers in one place creates a competitive (digital) marketplace for companies searching for cost efficient, redundant, high-speed Internet access for their latency-critical ICT services (Gerpott and Massengeil 2001; Malecki 2002). Therefore, colocation facilities provide the required environment for ICT-based services that demand extremely high network bandwidth, processing power, and storage capacity (Tilson et al. 2010). For example, in the financial services industry, electronic trading platforms benefit from direct access to stock exchanges due to low network latency provided in colocation facilities with direct Internet backbone access. Because these trading systems have to react to changes in the market instantaneously, the speed of execution and prompt availability of real-time market data is of paramount importance (Gsell 2009). Moreover, manufacturing firms with complex intermeshed systems, characterized by a constant information exchange, can benefit from colocation since servicing their network requires a reliable high performance network backbone. Accordingly, a colocation strategy can be defined as a corporate decision to use colocation centers to benefit from sophisticated data center services (offered by colocation service providers) as well as to leverage the benefits of a powerful ICT infrastructure (offered by ICT infrastructure providers, such as network carriers, WAN providers, and ISPs). Colocation strategy adoption then refers to the extent to which its specific business activities are facilitated by the firm's use of the ICT infrastructure services provided within a colocation center.

Theoretical Background

Analyzing the driving factors that affect the decision of a firm (i.e., its top management) to pursue and support an innovative ICT sourcing strategy, such as a colocation strategy, requires the development of a research model that is based on a strategic management perspective and regards firms as elements of a system where they are in a continuous state of interaction with their environments. Previous research (e.g., Fichman 2001) has mainly focused on a rational perspective that theorizes on ICT innovation assimilation based on rational decision-making factors, such as advantages that come from a specific technology, organizational factors (e.g., firm size, firm strategy, organizational structures of a firm), or industry characteristics. According to the institutional theory (DiMaggio and Powell 1983), recent studies have begun to investigate different forms of institutional pressures (e.g., normative, coercive, mimetic) as further decision factors (e.g., Liang et al. 2007; Teo et al. 2003). However, existing research widely neglected to control for environmental conditions and associated uncertainties as well as other factors and constraints that limit decision-making and rationality. Moreover, much of the existing research has concentrated on the intention of companies to adopt a specific innovation. Although these insights are helpful to understand the motivation behind (potential) adoption decisions, a deeper understanding of the post-adoption usage is needed. Accordingly, the theoretical framework proposed in the next section accounts for specific relative advantages of an innovation as well as environmental factors from a post-implementation perspective. Therefore, the foundation of our theoretical framework comprises four elements: the role of the top management as decision-maker and driving force with regard to the assimilation of innovations (Liang et al. 2007), relative advantages as innovation-specific influence factors (Rogers 1995), institutional pressures as environmental factors (DiMaggio and Powell 1983), and the role of environmental turbulence as a source of uncertainty (Pavlou and El Sawy 2006).

Top Management as Decision Makers and Impetus

With regard to the decision of a firm to adopt a specific innovation, higher management levels have been found to play an important role in the decision-making process (Kelly and Coaker 1976), being the main driving force in innovation assimilation (Liang et al. 2007). Consistent with the extant literature, top management serves as main human agency for absorbing and conversing drivers and institutional pressures arising from the environment to operational course of action (Liang et al. 2007). In contrast to the concept of institutional isomorphism, top management support was found to partly influence the differing assimilation behaviors among firms although they were exposed to the same level of institutional pressure (Teo et al. 2003). This diversity arises from different views and subsequent decision-making by top managers about relative advantages and required changes in organizational structures for accommodating institutional pressure. Therefore, top management exhibits a boundary spanning role in integrating external with internal knowledge (Mitchell 2006).

Relative Advantages as Innovation-Specific Influence Factors

In diffusion of innovation theory, relative advantages are conceptualized as a multi-dimensional construct that defines the degree to which using an innovation is perceived as being better than using the practice it supersedes (Rogers 1995). Since the specific benefits of a colocation strategy may differ from other ICT sourcing strategies, we conducted a Delphi study as a systematic expert survey in order to identify innovation-specific factors that impact on the management’s decision to support a colocation strategy. The study revealed three different dimensions presented in the following.

Cost advantages: If we focus on firms pursuing economic efficiency, cost is a major driving factor that determines if the pursuit of a new ICT sourcing strategy (e.g., colocation strategy) is beneficial. Colocation service providers can achieve economies of scale and scope by specializing in the operation of off-site data center space. The synergies result from cost advantages in the construction of energy-efficient data center space, bulk purchase of electricity, server racks, generators, etc., and the distribution of expenses for qualified personnel services and other business resources. Furthermore, an inter-organizational collaboration environment emerges where a large number of participants share information and exchange business services (Bakos 1998). When objectives are highly compatible, the cooperation of different companies in a networked relationship allows for the optimization of the various business activities at a total cost that is lower than that incurred through vertical integration or hierarchical governance.

Improvements in business flexibility: Especially in the context of dynamic markets, capabilities to explore, exploit, and capture market opportunities and relentless innovations in a timely manner is an important imperative for organizational success (Brown and Eisenhardt 1997). Porter and Ketels (2003) highlight that clustering and networking translates into innovative outcomes and that inter-organizational collaboration is essential for the development of innovative and dynamic capabilities. The wide range of network carriers, ISPs, and WAN providers in colocation centers provide industry firms with different infrastructure services and opportunities for cooperation. Flexible and scalable capacity adjustments as well as ad-hoc access to ICT resources allow enhanced inter-firm interactions that are crucial for sustainable and successful business relationships. The efficient ICT infrastructures can lower transaction costs by making business-relevant information more readily available (Rangan and Sengul 2009).

Innovation-specific benefits: In order to fully utilize existing resources and capabilities and to gain relative advantages, it is necessary for firms to leverage complementary resources and capabilities from specialist companies (Barney 1991). Since most colocation centers exhibit sophisticated data center equipment, customers can purchase these infrastructure services to improve their business operations. Moreover, since most of the large ICT infrastructure providers present in colocation centers operate fiberoptic networks that lead to the provision of high-speed and redundant connections to the Internet, customers can benefit from higher data transmission rates that satisfy the rising need for large transmission capacities. In addition, the adoption of a colocation strategy is a way to exploit the professional knowledge and skills of the colocation service provider and their business partners in the (digital) value-added network.

Institutional Pressures as Environmental Influence Factors

The innovation and decision-making processes of a firm are embedded in an environmental context (Aldrich 1979). Therefore, they have to align their strategic decisions with the changing of social, technical, and political environments. In order to control for these influence effects on organizational behavior, such as the adoption or diffusion of innovations, we consider the implications of the new institutional theory (e.g., DiMaggio and Powell 1983). Institutional theory in general posits that strategic decisions and corresponding structural and behavioral changes in firms are rather driven by the need for organizational legitimacy than by competition and the desire for efficiency (Teo et al. 2003). This continuous search for organizational legitimacy eventually facilitates the process of institutionalization and organizational isomorphism, especially against the background of an uncertain and turbulent environment. Accordingly, institutional theory argues that the institutional environment of a firm implies significant impact on its structure and actions (Burns and Wholey 1993). Focusing on institutional pressures and influences that may have an impact on the adoption of inter-organizational systems (IOS), Teo et al. (2003) developed a theoretical model that is based on three types of isomorphic pressures proposed by DiMaggio and Powell (1983): coercive, normative, and mimetic pressure. Mimetic pressure reflects the pressure to imitate structurally equivalent successful firms in the same industry without necessarily considering the firm-specific context. Coercive pressure is defined by the pressure grounded in societal expectations and dependencies towards other companies. Furthermore, various government and industry regulations exert coercive pressure on companies and decisively drive the adoption of new technologies or the pursuit of innovative business strategies. Pressure that is rooted in the ongoing process of professionalization is encompassed by normative pressure. This pressure arises from the exchange of best practices among business partners, suppliers, and the government.

Turbulent Environment as Source of Uncertainty

Previous scientific research has shown that environmental characteristics have a considerable impact on corporate strategy and outcomes (Eisenhardt and Martin 2000). The concept of environmental turbulence encompasses environmental conditions of uncertainty and unpredictability due to massive and rapid changes in technological developments and market preferences (Jaworski and Kohli 1993). Accordingly, this concept can be used to characterize the environment referring to market and technological turbulence as well as the related uncertainties (Atuahene-Gima and Li 2004). Market turbulence captures the heterogeneity and variability of the preferences and demands of the market, whereas technological turbulence refers to the rate of technological change (Jaworski and Kohli 1993). The consequences of environmental turbulence demand for organizational sensemaking and responsiveness in order to safeguard organizational outcome performance. In this context, companies can be seen as sensemaking units that are stimulated by environmental turbulence and constantly challenged to identify the contextually appropriate response (McGill et al. 1994). Indeed, existing studies also show that uncertainties often lead to mimetic behavior (Villadsen et al. 2010). Accordingly, firms tend to model themselves after other legitimate members in their field due to incomplete information about the further developments.

Research Model and Hypotheses

To empirically validate the impact of relative advantages as well as institutional pressures on the adoption of a colocation strategy, we developed the research model depicted in Figure 1. The model incorporates a newly-developed construct that measures the relative advantages of companies arising from the pursuit of a colocation strategy, in terms of cost advantages, improvements in business flexibility, as well as innovation-specific benefits. With regard to institutional pressures, existing literature (e.g., DiMaggio and

Powell 1983) emphasizes that effects of these kinds of environmental pressures are not always clearly identifiable. One of the major problems discussed in literature is that normative pressure may be confounded with mimetic and coercive pressures (e.g., Chen et al. 2009). In particular, the distinction between normative and mimetic pressures is not empirically clear (Burns and Wholey 1993) although they are theoretically different from each other. We therefore followed the argumentation of Chen et al. (2009) and excluded normative pressure from our study. This allowed us to eliminate a great amount of potential confounding factors. The model also incorporates top management support that has been suggested in previous research (e.g., Liang et al. 2007) to mediate institutional pressures in the process of technology or strategy adoption. Thus, we also hypothesize that relative advantages are mediated by top management in analogy. Lastly, we incorporated environmental turbulence as a source of uncertainty concerning the correctness, completeness, and sustainability of information available to decision-makers. In the following, we provide the hypotheses of our research model and the rationale behind them.

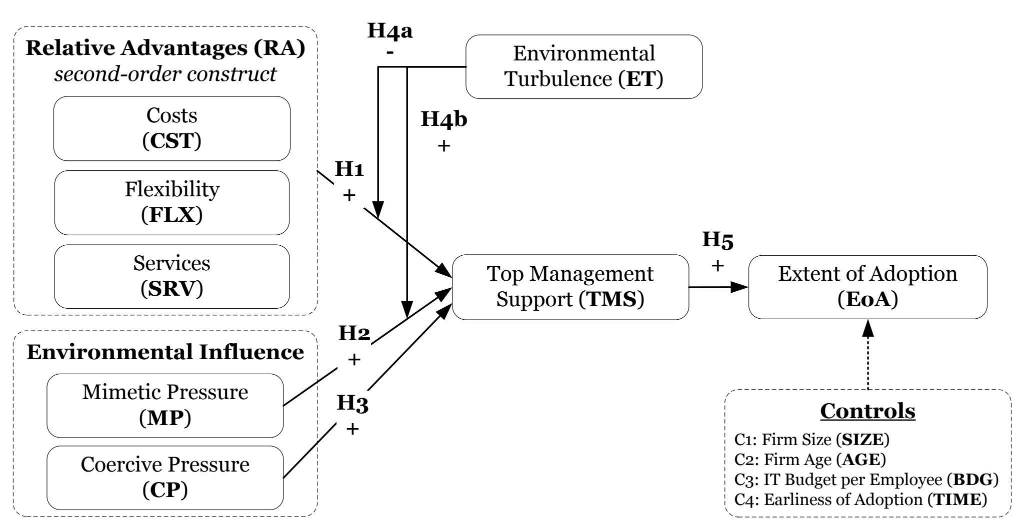

Figure 1. Structural model

Previous empirical studies suggest that relative advantages, defined as the degree to which using an innovation is perceived as being better than using the practice it supersedes, is the best predictor of adoption/usage (e.g., Rogers 1995). Since top management is in the position to identify business opportunities for the exploitation of innovations (Thong et al. 1996), specific characteristics representing the relative advantages are hypothesized to have an impact on top managers' decision to adopt colocation services, which can be regarded as an ICT sourcing strategy. With increasing relative advantage of ICT infrastructure services sourced from a colocation site compared to an in-house data center, top management will adopt colocation services as a strategic solution to benefit from these advantages. Hence, we propose:

Hypothesis H1: Higher levels of relative advantages lead to stronger top management support in the process of colocation strategy adoption.

According to the new institutional theory, uncertainty is a central concept used to explain why firms tend to model themselves after other legitimate members in their field. This modeling process is called mimetic isomorphism (DiMaggio and Powell 1983) and has already been shown to positively impact top management in the process of innovation adoption (e.g., Liang et al. 2007). This can lead to "bandwagon phenomena" where firms mimic the adoption decision of their competitors if they are regarded as successful, e.g., in terms of increased business outcomes. Thus, we hypothesize:

Hypothesis H2: Higher levels of mimetic pressure lead to stronger top management support in the process of colocation strategy adoption.

Coercive pressure arises from societal expectations in a broader sense where firms try to conform to expectations, policies, or regulations from the government, customers, or the competitive environment, and decisively drive the adoption of new business strategies and technologies (e.g., Zhu et al. 2006). Today, companies are facing increased governmental regulations and competitive conditions in their markets, which is why they seek to develop and introduce an efficient, effective, and flexible ICT infrastructure to meet the regulatory requirements and increased customer demands. Since a colocation strategy provides top managers with an instrument to resist coercive pressure imposed by government and industry regulations, we suggest:

Hypothesis H3: Higher levels of coercive pressure lead to stronger top management support in the process of colocation strategy adoption.

Environmental turbulence encompasses environmental conditions of uncertainty and unpredictability with regard to future conditions and with respect to future actions of others (Pavlou and El Sawy 2006). Hence, a decision-making process that is based on reliable information on the characteristics of the situation and the identification of relative advantage becomes even more complex. In these circumstances, firms tend to turn away from rational decision-making and instead follow their intuition (Radford 1978). Moreover, existing studies emphasize that a higher level of uncertainty leads to mimetic behavior of firms (e.g., Villadsen et al. 2010). Accordingly, firms operating in highly turbulent markets are more likely to follow potential bandwagon phenomena compared to firms operating in relatively stable markets. Hence, we posit that in highly turbulent markets, the adoption decision of top management is influenced by mimetic pressures rather than the beneficial characteristics of an innovation that might provide relative advantages to the firms. Due to this, we suggest:

Hypothesis H4a: In turbulent markets, compared to stable markets, relative advantages lead to lower top management support in the process of colocation strategy adoption.

Hypothesis H4b: In turbulent markets, compared to stable markets, mimetic pressure leads to stronger top management support in the process of colocation strategy adoption.

Top management support of IT refers to the degree to which top management fosters IT activities (Ragu-Nathan et al. 2004). Several empirical studies emphasize on the significant impact of top management on technology and strategy adoption (e.g., Chatterjee et al. 2002). This means that when top management understands the benefits and the function of a specific technology or strategy, the likelihood of top management support increases. With regard to colocation strategy, top management can legitimize colocation adoption by demonstrating its commitment and political support in the deployment initiative. This awareness of the top management is likely to facilitate the process of colocation strategy adoption. Hence, we propose:

Hypothesis H5: Higher levels of top management support lead to a higher extent of adoption.

In addition to the factors of interest, control variables are incorporated to better explain cross-sectional variations in the extent of colocation strategy adoption. In order to account for differences among the investigated companies, the study includes “firm size” (Zhu et al. 2006), “firm age” (Jayanthi et al. 2009), “IT budget per employee” (Ray et al. 2005), and “earliness of adoption” (Fichman 2001) as control factors. Rogers (1995) suggests that firm size may be positively related to innovation adoption since large firms are more likely to exhibit slack resources. Moreover, one could expect older, more established businesses to have sufficient resources and greater experience in hosting ICT infrastructures in their own data center facilities (internal hosting). Therefore, we included firm age, measured as the number of years that a firm had been in business, as a second control factor. The third control variable is used as a measure to capture a firm’s level of IT intensity. The fourth control variable captures the fact that firms that initiated colocation activities earlier had more time to reach more mature stages of colocation strategy adoption. In a separate robustness check, we also included indicator variables for the different industries to control for industry-specific characteristics. Following the literature (Chatterjee et al. 2002; Zhu et al. 2006), we incorporated industry dummies as control variables.

Empirical Study

In order to operationalize and empirically validate our research model, we employed a multi-method research design that entailed two phases.

In the *exploratory phase*, we conducted a Delphi study that aimed at identifying the relative advantages of a colocation strategy that influences the top management's decision to adopt a colocation strategy. To adequately account for the specific research context as well as to ensure model completeness and practical relevance, the Delphi study also attempted to identify business activities that can be facilitated by utilizing colocation services and to adapt the constructs to the research context of our study. The Delphi method is a structured, multi-pass group decision process developed to address research problems where there is no rigid answer. Many variations of the Delphi method have been used in the fields of IS, public policy, management, marketing, and group therapy (e.g., Brancheau and Wetherbe 1987; Keil et al. 2002). In our study, a panel of 30 domain experts was selected and each expert was asked to indicate independently what he or she thought are the most important advantages of colocation and which business activities can benefit most from a colocation strategy. Individual responses were collected and aggregated, and a list of the advantages and activities uncovered was presented to each panelist. Each panelist was then asked to rank the advantages and activities identified by the group as a whole in terms of significance. These rankings were analyzed and aggregated to an overall ranking. These re-ranked advantages and activities were then shown to each expert along with their original ranking and the experts were invited to review the aggregated group response. As a result, the most important advantages of a colocation strategy and business activities that benefit from a colocation strategy were identified and were used to adapt the measurement items to our specific research context. After the Delphi study, additional expert interviews were conducted to refine the wording of the indicators and to pre-test the research model.

In the *confirmatory phase*, the proposed research model was validated by using the partial least squares (PLS) method which is a component-based structural equation modeling (SEM) technique (Chin et al. 2003). PLS was found to be appropriate for the following reasons: First, PLS is able to handle measurement errors in exogenous variables and second, it requires fewer distributional assumptions about the data (Chin 1998). Third, the flexibility of PLS to accommodate both exploratory and confirmatory analysis made it a suitable method for our research context. Finally, PLS is able to accommodate smaller data sample models and latent constructs under conditions of non-normality in small to medium-sized samples (Chin 1998). In this study, the results for the PLS estimation are obtained from SmartPLS (Version 2.0 M3) that are illustrated in the following subsections.

Measures Securing Content Validity

Whenever possible, existing measures from previous empirical studies were deductively derived and adapted to the context where necessary, e.g., in the case of "mimetic pressure" (MP), "coercive pressure" (CP), "environmental turbulence" (ET), and "top management support" (TMS). Each construct of the research model is represented by a set of indicators that are presented in Table A1 in the Appendix. For all constructs, except for the construct "extent of adoption" (EoA), reflective indicators were used and measured on a fully anchored 7-point Likert scale, ranging from "strongly agree" to "strongly disagree". The second-order construct "relative advantage" (RA) was operationalized based on the results of the exploratory phase described above and consists of three sub-constructs (cost advantages, improvements in business flexibility, and innovation-specific benefits). As unit of analysis for measuring the extent of adoption, a business process perspective was chosen. In particular, the volume dimension, as identified by Massetti and Zmud (1996) was used as a guide for the development of a formative four-item construct. Finally, based on the result of the Delphi study, the extent of adoption was measured by asking the respondents to which degree four key business activities are facilitated in a colocation center: (1) hosting of business applications, (2) hosting of storage or storage-area networks, (3) hosting of websites, Internet portals, and e-business infrastructures, and (4) connection to carriers, WAN providers, and ISPs.

It has to be noted that most operationalizations of the CP construct (e.g., Teo et al. 2003; Liang et al. 2007) contain the item "vendor pressure". However, we excluded this item from our operationalization of CP since our expert interviews with colocation strategy adopters revealed that the managers differently interpreted the term "vendor" due to the different perspectives and characteristics of the heterogeneous industry sectors. For example, firms from the digital media and news industry regard media agencies and journalists as being their main vendors which do not exert any coercive pressure. However, one can also regard IT service providers (e.g., hosting providers for online media platforms) as being their vendors that may impact their adoption decision. Due to this threat of misinterpretation that may lead to confounding effects in the data analysis, we excluded the "vendor pressure" item from our measurement model.

Data Collection and Sample Profile

The study aimed at strategic decision-makers from different industry sectors in Germany that have adopted a colocation strategy for at least one of the four analyzed business activities. From an empirical perspective, focusing on a single country allowed us to control for extraneous country-specific factors that could otherwise confound the analysis, thereby enhancing internal validity. In October 2009, 1,012 members of a German business panel were invited by the authors to respond to the survey by filling out the online questionnaire. After one week, an email reminder was sent to non-respondents. In total, 142 responses were returned, indicating a response rate of 14.0 percent. In order to control for a non-response and late-response bias, we conducted t-tests to compare the mean values of the early versus late responses (Armstrong et al. 1977) and found that the responses did not differ significantly from each other.

Since the study aimed at colocation strategy adopters, the study participants were asked to indicate if they had already adopted a colocation strategy or not. Moreover, we excluded firms that primarily offer ICT services (e.g., network carriers, WAN providers, and ISPs) since the focus of our study was placed on adopters of colocated ICT services. In doing so, 28 responses from non-colocation strategy adopters and 49 responses from ICT infrastructure providers were removed, leading to a final sample of 65 valid responses for this study. The key characteristics of the sample are shown in Table 1. The descriptive data demonstrate that the participating firms belong to a variety of industry sectors, with the majority of service providers heavily relying on a powerful ICT infrastructure, such as the digital media, financial services, or online retail & e-business industry. The figures show that the firms are pursuing a colocation strategy for more than five years on average. As discussed below, some of these organizational factors were also included as control variables in our data analysis. Since the respondents were senior executives responsible for the ICT infrastructures in their respective firms, it can be assumed that they are familiar with different sourcing strategies in general and have significant knowledge about colocation hosting activities in their firm. In other words, their response can be assumed to represent the organizational perspective. Because the data were obtained from one key respondent from each firm, we conducted a Harman's one-factor test (Podsakoff and Organ 1986). The results show that one factor cannot adequately account for the variance, which indicates that the common method bias is not a threat to the validity of our study. Following Podsakoff et al. (2003) and Liang et al. (2007), we also tested a PLS model with a single, latent method factor in the measurement model. The constructs explained considerably more variance in the data set than the common method factor, further suggesting that the common method bias is not likely to impact our results significantly.

Table 1. Sample characteristics (N = 65)

Industry sector		**Firm size (#employees)**		**Firm age**	
Digital media / news	7 (11%)	≤ 250	22 (34%)	< 5 years	11 (17%)
Financial services	6 (9%)	251 - 1,000	14 (21%)	5-10 years	8 (12%)
IT development & systems integrator	11 (17%)	1,001 - 5,000	9 (14%)	10-20 years	15 (23%)
Manufacturing & logistics	10 (15%)	5,001 - 10,000	9 (14%)	20-50 years	15 (23%)
Online retail & e-business	5 (8%)	> 10,000	11 (17%)	> 50 years	16 (25%)
Public sector	6 (9%)	**Year of first colocation adoption**			
Consulting & software development	8 (12%)	< 2000	21 (32%)		
Wholesale & retail	3 (5%)	2000-2003	15 (23%)		
Other services provider	9 (14%)	2003-2006	14 (22%)		
		2006-2009	15 (23%)		
Respondent's position		**Respondent's tenure**			
C- level management (CTO, COO, CIO)	19 (29%)	≤ 2	5 (8%)		
Business unit directors (ICT & Operation)	23 (35%)	2 - 5	6 (9%)		
ICT project manager	16 (25%)	5 - 10	14 (22%)		
Other ICT decision-maker	7 (11%)	10 -15	17 (26%)		
		> 15	23 (35%)		

Validation of the Measurement Model

The evaluation of reflective as well as formative models includes the assessment of content validity, construct reliability, and construct validity. In the previous section, we already discussed content validity.

Construct reliability is concerned with the internal consistency of the measurement model (Straub et al. 2004) and measures the degree to which items are free from random error and therefore yield consistent results. The examination of reflective constructs' reliability was assessed by using the average variance extracted (AVE), the composite reliability, and the Cronbach's alpha scores. The AVE measures the amount of variance that a construct captures from its indicators relative to the amount due to measurement error (Chin 1998). As indicated in Table 2, the AVE of each construct is above the recommended threshold of 0.5 (Fornell and Larcker 1981), meaning that at least 50 percent of measurement variance is captured by the construct. The composite reliability (Werts et al. 1974) is an aggregate measure of the degree of inter-correlation or internal consistency among measurement items of the same construct and indicates how reliably the construct is represented by the indicators (Chin 1998). Table 2 shows that the composite reliability score of each construct is above the recommended threshold of 0.7 (Hair et al. 1998) providing evidence for sufficient reliability. Cronbach's alpha (Cronbach 1951) is a traditional and alternative measure for estimating internal consistency and assumes equal weights of all the items of a construct and is influenced by the number of items. As presented in Table 2, all Cronbach's alpha values exceed the critical value of 0.7 (Nunnally 1978), providing further indication of internal consistency among the measurement items.

Table 2. Means, standard deviations, AVEs, composite reliabilities (CR), Cronbach's alphas, and correlations among constructs (off-diagonal elements), square root of AVEs (diagonal elements)

	Mean	SD	AVE	CR	Alpha	RA+	MP	CP	TMS	ET	EoA*	SIZE#	AGE#	BDG#	TIME#
RA+	6.17	2.07	–	–	–	–									
MP	4.04	1.06	0.79	0.92	0.87	-0.09	**0.89**								
CP	4.01	1.31	0.64	0.84	0.81	-0.01	0.47	**0.80**							
TMS	4.62	1.22	0.64	0.91	0.88	0.27	0.30	0.48	**0.80**						
ET	5.05	1.08	0.63	0.90	0.87	0.33	0.35	0.34	0.41	**0.79**					
EoA*	1.91	1.40	–	–	–	0.02	-0.07	0.05	0.39	0.18	–				
SIZE#	3.26	2.29	1.00	1.00	1.00	-0.10	0.14	-0.04	0.03	0.07	0.11	**1.00**			
AGE#	41	49	1.00	1.00	1.00	-0.09	-0.01	-0.25	-0.16	-0.32	0.10	0.53	**1.00**		
BDG#	31.01	25.01	1.00	1.00	1.00	-0.19	-0.0	0.01	-0.06	-0.23	0.28	-0.14	0.07	**1.00**	
TIME#	3.23	3.10	1.00	1.00	1.00	0.01	-0.17	-0.01	0.23	0.14	0.52	-0.10	0.06	0.25	**1.00**

Legend: * formative construct, + reflective-formative second-order construct, # 1-item measure (controls)

Construct reliability of the formative construct is checked by testing for multicollinearity and indicator validity (path coefficients and path significance) (Petter et al. 2007). Multicollinearity does not affect the predictive effectiveness of the formative construct but may lead to estimation biases and instability of the indicators' coefficients which render problematic indicator validity and hence leads to overall problematic construct reliability (MacKenzie et al. 2005). The magnitude of multicollinearity was assessed statistically by the variance inflation factor (VIF). As shown in Table 3, the VIF scores for the EoA construct are below the recommended level of 3.3 (Petter et al. 2007), which indicates the absence of multicollinearity.

Table 3. Weights, t values, VIF values

	weight	t value	VIF			weight	t value	VIF
RA	0.11	1.20	1.51		**EoA1**	0.38	2.75	3.06
MP	0.33	2.53	1.36		**EoA2**	0.32	2.38	2.86
ET	0.17	1.65	1.29		**EoA3**	0.21	2.20	1.40
MPxET	0.27	2.35	1.14		**EoA4**	0.47	5.04	1.05
RAxET	-0.19	1.74	1.38					

Unlike construct reliability where the measurement within the construct is an issue, construct validity refers to the wider, out of the construct validation of its measures (Straub et al. 2004). Construct validity is related to exposing whether indicators of the construct indeed measure what they intend to from the perspective of relationships between constructs and between constructs and their indicators. The validity of the constructs was assessed in terms of (1) convergent validity and (2) discriminant validity (Campbell and Fiske 1959).

Table 4. Loadings and cross-loadings for items

	COS	SER	FLX	MP	CP	TMS	ET	EoA*
COS1	**0.89**	0.71	0.59	0.16	0.00	0.09	0.37	0.12
COS2	**0.89**	0.60	0.81	0.26	0.03	0.04	0.22	-0.06
SER1	0.54	**0.83**	0.63	0.02	0.01	0.16	0.38	0.01
SER2	0.70	**0.89**	0.59	0.06	-0.01	0.18	0.49	0.07
SER3	0.73	**0.89**	0.73	0.12	-0.02	0.16	0.38	0.01
SER4	0.67	**0.92**	0.72	0.08	0.04	0.29	0.43	0.06
SER5	0.66	**0.85**	0.66	0.09	0.05	0.22	0.41	-0.01
FLX1	0.64	0.71	**0.93**	0.19	0.10	0.10	0.21	-0.08
FLX2	0.67	0.58	**0.78**	0.22	0.04	0.08	0.35	-0.11
MP1	0.20	0.17	0.28	**0.90**	0.46	0.34	0.32	-0.02
MP2	0.17	-0.01	0.11	**0.92**	0.42	0.24	0.27	-0.01
MP3	0.22	0.03	0.18	**0.85**	0.36	0.19	0.26	0.00
CP1	-0.23	-0.20	-0.05	0.43	**0.62**	0.24	0.05	-0.19
CP2	0.06	0.01	0.11	0.49	**0.92**	0.44	0.31	0.02
CP3	0.09	0.13	0.10	0.26	**0.83**	0.43	0.36	0.25
TMS1	-0.06	-0.04	-0.08	0.29	0.55	**0.71**	0.34	0.42
TMS2	0.22	0.34	0.23	0.23	0.24	**0.82**	0.35	0.24
TMS3	0.01	0.24	0.05	0.25	0.35	**0.89**	0.37	0.44
TMS4	-0.05	0.09	-0.04	0.31	0.44	**0.82**	0.31	0.25
TMS5	0.15	0.23	0.11	0.04	0.20	**0.76**	0.26	0.37
TMS6	0.13	0.28	0.28	0.28	0.47	**0.76**	0.28	0.06
ET1	0.26	0.42	0.24	0.36	0.33	0.37	**0.84**	0.19
ET2	0.15	0.28	0.23	0.35	0.31	0.26	**0.69**	0.16
ET3	0.26	0.40	0.20	0.11	0.11	0.37	**0.78**	0.05
ET4	0.03	0.09	0.08	0.24	0.28	0.33	**0.76**	0.20
ET5	0.25	0.40	0.22	0.11	0.11	0.37	**0.77**	-0.03
ET6	0.23	0.27	0.30	0.28	0.33	0.21	**0.49**	0.15
ET7	0.35	0.20	0.25	0.33	0.34	0.20	**0.73**	0.17
ET8	0.36	0.33	0.32	0.20	0.08	0.28	**0.71**	0.14
EoA1*	0.14	0.08	0.02	0.06	0.15	0.28	0.24	**0.65**
EoA2*	0.02	0.06	-0.09	-0.07	-0.01	0.35	0.16	**0.65**
EoA3*	-0.01	-0.04	-0.18	0.03	0.06	0.24	0.19	**0.60**
EoA4*	-0.03	-0.04	-0.10	-0.14	-0.05	0.27	0.08	**0.62**

Legend: * formative construct

To ensure *convergent validity*, it has to be tested if indicators of latent constructs that theoretically should be related to each other are in fact observed to be related to each other. However, since formative indicators may be positively or negatively correlated, or completely uncorrelated (Bollen and Lennox 1991), we only examined convergent validity of reflective constructs by measuring the degree to which the variance of an indicator can be explained by the underlying construct and can be assessed by the indicator loadings (indicator reliability). As can be seen in Table 4 (bold numbers), almost all loadings of the reflective constructs are above the recommended threshold of 0.707 (Chin 1998), indicating that there exists more shared variance between the construct and its indicators than error variance (Hair et al. 1998) and that the measurement items used were adequate for measuring each construct.

Discriminant validity assesses whether indicators of latent constructs that theoretically should not be related to each other are, in fact, observed as not related to each other. MacKenzie et al. (2005) propose an approach that is appropriate for the evaluation of discriminant validity for both formative and reflective measures. The test analyzes if the inter-construct correlations are not high, which indicates satisfactory discriminant validity of the constructs. Furthermore, discriminant validity for reflective constructs was assessed by analyzing the cross-loadings and the Fornell-Larcker criterion. The cross-loadings (Chin 1998) shown in Table 4 reveal that each indicator loading is much higher on its assigned construct than on the other constructs, providing evidence for sufficient discriminant validity on the indicator level (Henseler et al. 2009). The Fornell-Larcker criterion (Fornell and Larcker 1981) postulates that a construct shares more variance with its assigned indicators than with any other construct and is assessed by the relationships between the inter-construct correlations and the square root of AVEs. In statistical terms, the square root of the AVE for each construct should exceed the correlations involving the construct (Fornell and Larcker 1981; Gefen 2003). Table 2 shows that for each construct, the square root of the AVE score (number on the diagonal) is greater than the correlations between the construct and any other construct (off-diagonal numbers), which indicates satisfactory discriminant validity of all constructs. Since all constructs showed convergent validity and discriminant validity and all indicators satisfied various reliability and validity criteria, they were used to test the structural model and the proposed hypotheses.

Validation of the Structural Model

To estimate the parameters in the measurement and the structural model, we used PLS path modeling with a path weighting scheme for the inside approximation. Because PLS does not directly provide significance tests, the non-parametric bootstrap re-sampling method was conducted to provide confidence intervals for all parameter estimates. Specifically, the performance of an estimator of interest depends on its parameter and standard error bias, relative to repeated random samples drawn with replacement from the original observed sample data (Marcoulides and Saunders 2006). We pre-specified 500 bootstrap samples and conducted the procedure to test the significance of the path estimates, factor loadings, and weights.

In order to model the second-order construct RA, a two-stage approach (Yi and Davis 2003) was used. Hence, latent variable scores were generated from an initial analysis of first-order constructs. Moreover, to test for mediation effects through TMS, we analyzed both the direct and indirect effects of RA, MP, and CP on EoA. While the indirect effects (mediated effects) of RA and CP on EoA (mediated by TMS) are significant (see Table 5), the direct path coefficients still remain insignificant, suggesting full mediation through TMS. Furthermore, the direct and indirect path coefficients of MP are insignificant. Moderation effects of ET were estimated by following the procedure laid out by Chin et al. (2003). First, to reduce multicollinearity, we standardized all indicators. Then, by using the standardized indicators of the predictor and moderator variables, product indicators were generated to reflect the latent interaction variables. The PLS procedure was then applied to estimate the dependent variable TMS. Considering the potential high inter-correlations among the main effects (RA, MP, and ET) and the interaction terms (RAxET, MPxET), the potential threat of multicollinearity was assessed statistically by analyzing VIF scores. As we show in Table 3, the VIF scores of the exogenous variables are lower than the recommended level of 3.3, which indicates an absence of multicollinearity (Petter et al. 2007).

Moreover, we compared three nested models for each dependent variable to check for robustness of our results (see Table 5, Model 1: a baseline model with all main effects; Model 2: Model 1 plus control variables; Model 3: Model 2 plus interaction effects). These models are fully nested so that the difference in the explanatory power enables a valid model comparison in terms of effect sizes. The explanatory power of the structural model is measured by the squared multiple correlations (R^2) of the dependent variables. The effect size (f^2) denotes the strength of the theoretical relationship found in the analysis and provides an estimation of the degree to which a phenomenon exists in a data sample (Chin et al. 2003). According to Cohen's (1988) approach, we used the differences in R^2 to calculate the f^2 scores.

Table 5. Empirical results; * p < 0.1, ** p < 0.05 (two-tailed)

Relationships		**Model 1** *(Main Effects)*	**Model 2** *(Model 1 + Controls)*	**Model 3** *(Model 2 + Interaction Effects)*	**Effect Size** (f^2)
H1:	RA → TMS	0.23*	0.23*	0.17*	0.06
H2:	MP → TMS	0.08	0.08	0.11	0.04
H3:	CP → TMS	0.38**	0.38**	0.33**	0.17
H4a:	RAxET → TMS	–	–	- 0.19*	0.20
H4b:	MPxET → TMS	–	–	0.27**	
R^2 (TMS)		**0.33**	**0.33**	**0.44**	
H5:	TMS → EoA	0.43**	0.30**	0.30**	0.11
C1:	SIZE → EoA	–	0.18	0.18	0.03
C2:	AGE → EoA	–	0.03	0.03	0.00
C3:	BDG → EoA	–	0.41**	0.41**	0.14
C4:	TIME → EoA	–	0.21*	0.21*	0.06
R^2 (EoA)		**0.20**	**0.41**	**0.41**	

As can be seen in Table 5, except for the relationship between MP and TMS, all path coefficients are significant. Hence, five of six hypotheses are supported by the survey data, whereas hypothesis H2 is not supported due to the insignificant path coefficient. The empirical results further indicate that the effect of RA is negatively and the effect of MP is positively moderated by ET (as a source of uncertainty), thus supporting both hypotheses H4a and H4b. The R^2 values of both dependent variables are above 0.33, indicating that, according to Chin (1998), the model explains a moderate amount of variance of the dependent variables. In particular, Model 3 explained 44 percent of the variance in TMS, an increase of 10 percent compared to Model 2 (main-effects-only model based on Liang et al. 2007). The analysis of the effect sizes (Cohen 1992) further confirms the explanatory power of ET as a moderator. Thereby, we find that these results are not only statistically but also economically significant as indicated by their effect sizes. The high effect size of the interaction term indicates the strength of the theoretical relationship found in our analysis and thereby provides a solid estimation of the degree to which environmental turbulence influences the adoption decision process in our data sample. However, due to our relatively small sample size, we do not overestimate our findings and request further research to investigate similar relations with more representative samples.

With regard to the control variables, the survey results show that the two controls C3 and C4 are significantly related to the EoA construct. This means that firms with a larger IT budget are more likely to adopt a colocation strategy. Furthermore, firms that initiated colocation activities earlier have had more time to reach more mature stages of strategy adoption and hence a higher extent of adoption. However, the results show that the positive effect of TMS remains stable after controlling for other influence factors (SIZE, AGE, BDG, TIME).

As a robustness check, we estimated an alternative research model that includes dummy variables for each industry (instead of the firm-specific control variables) to control for cross-sectional industry-specific factors (e.g., ICT dependency, market development, economic situation) (Chatterjee et al. 2002; Zhu et al. 2006). The estimation results show an equivalent coefficient of the relation TMS → EoA (0.31**) and confirm higher adoption rates for industries that heavily depend on ICT infrastructures (e.g., digital media, online retail & e-business, and financial services). However, the alternative model shows a lower amount of explained variance of EoC (R^2 = 0.28). Hence, the results provide support for our initial model and we are reasonably confident in the robustness of the results.

Discussion

The results illustrate that environmental conditions (i.e., environmental turbulence) and related uncertainties extend the nomological network of influence factors (i.e., relative advantages, institutional pressures) to understand the adoption of a new ICT infrastructure strategy (i.e., sourcing of colocation services), mediated by top management support. According to relative advantages, colocation-induced flexibility (resulting from a large variety of ICT infrastructure providers, variable capacity adjustments, and collaboration opportunities) shows the highest impact factor. Of the two institutional pressures, only coercive pressure has a significant effect on the adoption of a colocation strategy. The results, therefore, indicate that government and industry regulations exert coercive pressure on companies and decisively drive the adoption of new technologies and business strategies (Zhu et al. 2006).

The hypothesis that mimetic pressure positively affects top management support and finally facilitates colocation strategy adoption is not supported by the survey data. In the theory development, we argue that top management mimics the decision of other firms who have (successfully) adopted colocation as an ICT sourcing strategy. Hence, we hypothesize that top management mediates the relationship between mimetic pressure and colocation strategy adoption. Instead, our empirical findings indicate that mimetic pressure does not exert a significant influence on the adoption decision process per se. This can be explained by the inherent uncertainty of the outcomes of such a sourcing initiative. Especially in the early adoption phase, top managers tend to avoid mimicking the actions of their successful competitors, which shields them against potential loss of face and helps to maintain the legitimacy of their decisions. This decision behavior is reflected in the term "uncertainty avoidance" (Hofstede 1980) which captures the extent to which a culture socializes its members into accepting ambiguous situations and tolerating uncertainty (Kaufmann and Carter 2006). In contrast to countries such as the United States and the United Kingdom that are viewed to be relatively open minded when it comes to change and risk taking and to embrace innovations, Germans generally are considered to be uncomfortable with unfamiliar behavior, resistant to change, consensus-seeking, and avoidant of conflict (Hofstede 2001). Hence, this high level of uncertainty avoidance in the German culture might be a possible explanation for the insignificant main effect of mimetic pressure on top management support. Summing up, our results indicate that firms that have already adopted a colocation strategy may not have reached the critical mass yet. From a more methodological point of view, the insignificant main effect of mimetic pressure in combination with the significant interaction term MPxET indicates the existence of subgroups (with regard to different magnitudes of mimetic pressure) in the data sample. Hence, future research might conduct a subgroup analysis to be able to elaborate on the insignificant path coefficient in more detail.

As hypothesized, the relationships between the investigated influence factors and top management support are not stable, depending on the degree of environmental turbulence. The results show that, in turbulent environments, mimetic pressure increases whereas the valuation of relative advantages decreases. This indicates increased mimetic isomorphism as a process in which uncertain, complex, or ambiguous situations cause top management to decide in a similar way as others to gain legitimacy and security (DiMaggio and Powell 1983). Nevertheless, mimetic decision-making and corresponding actions can also be based on information about other market participants. Therefore, imitation might also be a rational decision. Accordingly, it is important to recognize that not all top management decisions that can be regarded as mimetic decision-making are actually based on mimetic behavior (Oliver 1991). Moreover, since the realized business value was not considered in this study, no further evidence can be provided whether mimicry eventually leads to an increase or decrease of business value generation. But despite this, the results clearly indicate that mimetic isomorphism occurs when decision-makers are faced with an increased uncertainty and thus has to be carefully considered in future studies.

Managerial Implications

Our study on a specific ICT sourcing strategy has different implications for ICT decision-makers of colocation providers, ICT infrastructure and services providers, as well as potential colocation adopters. To start with, decision-makers generally can draw from the integrative framework developed in this paper to assess conditions for the adoption of colocation as an ICT sourcing strategy. First, senior ICT decision-makers need to be aware of the level of their participation that is required in the adoption process of a new ICT sourcing strategy (Liang et al. 2007). Moreover, our framework includes a series of important characteristics describing the nature of colocation, which may be useful for managers to evaluate colocation as a potential ICT sourcing initiative in terms of relative advantages, as well as institutional and environmental influence factors. The identified specific benefits of a colocation strategy could structure the management's decision process to support a colocation strategy. More importantly, the decision-makers need to be aware that with an increased environmental turbulence, they are exposed to a higher mimetic pressure. Accordingly, our results clearly demonstrate that firms tend to model themselves after other legitimate members in their field due to uncertainties (e.g., incomplete information about future developments). The awareness about these relations can help to improve sensing capabilities (through, e.g., better decision support systems) and enable a mindful decision-making process to identify contextually appropriate decisions.

Consequently, colocation providers should primarily focus on information about relative advantages of a colocation strategy, such as low capital expenditures, highly flexible and scalable capacity adjustments, the availability of a large number of ICT infrastructure and service providers (carriers, WAN providers, and ISPs) and a stable data center infrastructure (power, cooling, and extinguishing systems). However, our results suggest that especially in turbulent environments, in which the direct business advantages cannot be determined accurately, ICT sourcing providers should also focus on institutional influences to which potential adopters are exposed to. Accordingly, colocation providers should not only disclose information about the direct benefits for potential colocation strategy adopters, but should also provide meaningful information about the benefits for their customers (e.g., low latency which leads to faster website access and online transactions, stable Internet connection for continuous media streaming) to encourage a rational decision-making process. Furthermore, our results suggest that colocation providers should work closely with ICT councils, standardization committees, and industry associations since these institutions have the credibility to influence organizational decisions on ICT sourcing strategies. Due to the inherent residual uncertainty of the outcomes of ICT sourcing decisions, the promotion of successful adoptions will motivate the mind-set shift of potential adopters, enable learning effects, and provide effective guidance in decision-makings. Accordingly, colocation providers should describe concrete business cases with regard to firm-specific circumstances to encourage other firms to adopt a colocation strategy. This strategy serves the purpose of reducing managerial uncertainty pertaining to the innovation-specific characteristics and firm-specific environmental turbulences.

Finally, colocation adopters and ICT infrastructure and service providers may have self-interest in promoting the adoption of a colocation strategy among their (digital) value chain. The accumulation of network carriers, WAN providers, and ISPs in colocation data centers provides a high-performance ICT infrastructure with fast access to the Internet, which leads to a digital marketplace from which particularly ICT-intensive businesses can benefit due to the realization of synergies of scope (Gerpott and Massengeil 2001; Malecki 2002).

Limitations and Future Research

The most limiting factor of this study originates from the relatively limited sample of observations and corresponding degrees of freedom which restrict our analysis with regard to model complexity, possibilities of group comparison, and the number of control factors. For example, the use of industry dummy variables may not fully control for industry effects since other firm-specific characteristics could also influence the adoption of an ICT sourcing strategy. Moreover, our empirical results concerning the response to environmental turbulence may be affected by a cultural response to these stimuli specific to the country of choice. Accordingly, focusing on a single country (i.e., Germany) may lead to some bias when addressing the question on how uncertainty (resulting from environmental turbulence) leads to imitative ICT adoption behavior of firms. However, these limitations suggest avenues for further research in order to further validate and extend our research model. In this regard, group comparison analysis would be very promising. A balanced international sample could be used to estimate the structural model based on subsamples differentiated by cultural or structural dimensions. From a cultural perspective, it would be interesting to investigate the differences between cultures with a high and low level of uncertainty avoidance.

Moreover, in future research, our model could be extended to investigate how organizational capabilities (such as organizational mindfulness; Weick and Sutcliffe 2006) that may predict the quality of a decision-making process, influence the adoption process in turbulent environments. From a theoretical perspective and with regard to the existing research in behavioral economics (e.g., Kahneman 2003), future research should integrate and further investigate factors in order to account for cognitive capabilities, the amount of accessible information, as well as other restrictions that influence the rational decision process. Moreover, our theorizing is heavily driven by an institutional perspective and not so much by an adaptive learning perspective, although human beings and therefore also top managers are constantly engaged in active sensing, responding, and learning processes within different environmental conditions (Overby et al. 2006). Future studies can analyze how institutional pressures interact with such learning-related constructs to affect innovation adoption processes. In summary, the consequences of environmental turbulence demand for organizational sensemaking and responsiveness in order to safeguard organizational outcome performance. Accordingly, companies can be seen as sensemaking units that are stimulated by environmental turbulence and which are constantly challenged to identify the appropriate contextual response (McGill et al. 1994). Inter-organizational collaboration and information channels as well as innovative decision support systems may lead to an improved ability to sense environmental changes. Moreover, firms acquire effective and flexible ICT and sourcing solutions to mobilize internal as well as external resources and the related knowledge to respond to environmental conditions (Cassiman and Veugelers 2006). Therefore, future research is needed to identify and analyze appropriate ICT strategies and solutions that can enable corresponding sensing and responding capabilities.

Conclusion

Grounded in the well-established research streams on diffusion of innovation and new institutional theory, this paper explored a core mechanism underlying existing adoption and assimilation models by investigating environmental turbulence as a source of uncertainty. Prior research on ICT adoption and assimilation has mainly focused on a rational and institutional perspective by investigating factors such as organizational structures and capabilities as well as environmental pressures (e.g., Teo et al. 2003; Liang et al. 2007; Zhu et al. 2006). However, in doing so, controlling for different influence factors that restrict rational decisions as particularly identified in the emerging research field on behavioral economics (e.g., Kahneman 2003) was mainly neglected. Therefore, the main contribution of our research is the integration of environmental conditions (i.e., environmental turbulence) as a source for uncertainty that may lead to irrational decisions and activities. Therefore, the study aimed at investigating how uncertainty caused by turbulent environmental conditions affects imitative ICT adoption behavior of firms based on a restricted rational perspective.

Our research results provide a first indication that future studies need to pay attention to the multidimensionality of environmental conditions and uncertainty and its consequences resulting in, e.g., non-rational ICT adoption decisions. So far, little attention has been spent on the underlying organizational processes in which decision-makers are influenced by environmental uncertainty. We are at the beginning to understand how this influence is translated into organizational decision-making in the context of ICT adoption. Following this line of thinking, IS research has not considered so far how uncertainties are transformed into organizational actions. In order to gain a more complete understanding of this mechanism, we need more research that applies a micro-level instead of a macro-level approach (e.g., Davis and Marquis 2005) to demonstrate the interactive relations and diachronic effects between external pressures, environmental conditions, innovation-specific characteristics and benefits, ICT adoption decisions, and adoption processes over time.

Appendix

Table A1. Survey items

Relative Advantage (RA) *(reflective-formative second-order construct)*		7-point Likert (1 = strongly disagree; 7 = strongly agree)	Expert interviews, Delphi study
Please evaluate the importance of the following advantages:			
CST1	Availability and connectivity to carriers, WAN providers, and ISPs at a reasonable price		
CST2	Low setup and/or investment costs (low capital expenditure, CAPEX)		

FLX1	Flexible and scalable capacity adjustment by colocation provider	
FLX2	Large variety of carriers, WAN providers, and ISPs	
SRV1	High availability, redundancy, and stability of data center operations (power, cooling,	
SRV2	High know-how of the specialized colocation provider	
SRV3	High level of security and certification (e.g., ISO IEC 27001)	
SRV4	High regulatory compliance and warranty	
Mimetic Pressure (MP) *(reflective measures)*	7-point Likert (1 = strongly disagree; 7 = strongly agree)	Teo et al. (2003), Liang et al. (2007)
MP1	Our main competitors who have adopted a colocation strategy have greatly benefited	
MP2	Our main competitors who have adopted a colocation strategy are favorably perceived by others in the same industry	
MP3	Our main competitors who have adopted a colocation strategy are favorably perceived by their suppliers and customers	
Coercive Pressure (CP) *(reflective measures)*	7-point Likert (1 = strongly disagree; 7 = strongly agree)	Teo et al. (2003), Liang et al. (2007)
CP1	The increasing regulatory pressure requires our firm to use a colocation strategy	
CP2	The increasing customer demand requires our firm to use a colocation strategy	
CP3	The competitive conditions require our firm to use a colocation strategy	
Top Management Support (TMS) *(reflective measures)*	7-point Likert (1 = strongly disagree; 7 = strongly agree)	Ragu-Nathan et al. (2004)
TMS1	Top management defined colocation as corporate data centre strategy	
TMS2	Top management understands the importance of our colocation strategy	
TMS3	Top management supports our colocation strategy	
TMS4	Top management considers our colocation strategy as important	
TMS5	Top management understands the benefits of our colocation strategy	
TMS6	Top management is interested in colocation	
Environmental Turbulence (ET) *(reflective measures)*	7-point Likert (1 = strongly disagree; 7 = strongly agree)	Pavlou and El Sawy (2006), Jaworski and Kohli (1993)
ET1	The environment in our industry is continuously changing	
ET2	Environmental changes in our industry are very difficult to forecast	
ET3	The technology in our industry is changing rapidly	
ET4	Technological breakthroughs provide big opportunities in our industry	
ET5	In our kind of business, customers' product preferences change a lot over time	
ET6	Marketing practices in our product area are constantly changing	
ET7	New product introductions are very frequent in our market	
ET8	There are many competitors in our market	
Extent of Adoption (EoA) *(formative measure)*	5-point Likert (1 = 0-20%; 5 = 80-100%)	Massetti and Zmud (1996), Liang et al. (2007), expert interviews, Delphi study
Please rate the extent of your colocation-based activities in the following areas:		
EoA1	Hosting of business applications	
EoA2	Hosting of storage or storage-area-networks	
EoA3	Hosting of websites, Internet portals, and e-business infrastructures	
EoA4	Connection to carriers, WAN providers, and ISPs	
Controls *(1-item measures)*		Fichman (2001), Rogers (1995), Ray et al. (2005)
SIZE	Number of employees in firm (worldwide)	
AGE	Years elapsed since the foundation of the firm	
TIME	Years elapsed since the first colocation activity	
BDG	IT budget per employee	
DY_X	Dummy variables for each industry X ("1" = firm belongs to industry X; "0" = otherwise)	

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