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DOES UNCERTAINTY PLAY A VICIOUS ROLE IN IOS ADOPTION DECISIONS BY SMALL BUSINESS MANAGERS?[1]

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ABSTRACT

Aim/Purpose	Explores the interrelationships between uncertainty, motivation, and IT readiness when predicting IOS adoption among small businesses.
Background	Small business IOS adoption is proportionally low in most countries worldwide.
Methodology	Uses a sample of small businesses and PLS structural-equations path modelling approach.
Contribution	Uncertainty is an underexplored construct in information systems research, and our research shows that it plays a significant role in IOS adoption among small businesses
Findings	The findings support that uncertainty has a negative effect on intent to adopt IOS and that motivation and IT readiness have a positive effect.
Recommendations for Practitioners	To alleviate uncertainty, an effort to win over small business managers to IOS over the internet must encompass accessible information, security provisions, low-cost product, simple interfaces, and system adaptability to existing provisions in the IOS network.
Recommendations for Researchers	The uncertainty perspective has not been tested extensively empirically, especially not in the context of technology adoption, and needs further investigation.
Future Research	Future research could explore the uncertainty construct in the context of IOS among different size businesses

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Keywords uncertainty perspective, IOS, SME, small business, technology adoption, IT-enabled supply chains, electronic commerce

INTRODUCTION AND BACKGROUND

The developing science of informing has not yet explored the role of uncertainty. This research adds to that body of science by exploring uncertainty in the context of inter-organizational systems (IOS).

IOS over the internet opened floodgates of innovation and new services, enabling the interconnection of small enterprises with their trading partners. However, despite the incentives to integrate with supply chains, the many IOS choices and the reaction of others in the external environment (Lutfi, 2020) pose uncertainty for small business managers that must decide where to place precious resources for maximum value creation. Despite IOS innovations and potential benefits, small enterprises are still adopting IT-enabled IOS on a limited scale, causing value chain integration problems (Organization for Economic Co-operation and Development [OECD], 2017; Venkatesh & Bala, 2012). Since small businesses constitute most enterprises in the supply chain, it is essential to understand why adoption rates of IOS are lagging (Nguyen et al., 2015).

Research on IOS adoption offered several perspectives with important contributions that constitute the technology acceptance theory (Davis, 1989; Venkatesh, 2000; Venkatesh & Davis, 2000). The technology acceptance model (TAM) (Davis, 1989) decomposed beliefs into perceived ease of use and perceived usefulness, building on the theory of reasoned action (Fishbein & Ajzen, 1975) that used a causal chain of beliefs: attitude, intention, and actual behaviors. The TAM model has been extended over the years, culminating in TAM2 (Venkatesh & Davis, 2000) and later the unified theory of acceptance and use of technology (Venkatesh et al., 2003). However, the plethora of research into TAM has also yielded critical alternative perspectives and theoretical models unraveling the multifaceted aspects of the technology adoption decision (Dwivedi et al., 2019; Maruping et al., 2017).

Information system researchers know that small firms are not scaled-down versions of larger firms (Beckinsale et al., 2006; Kuan & Chau, 2001; Levy & Powell, 2003; Pollard & Hayne, 1998); small firms lack resources in comparison. Consequently, the perceived risk in resource allocation to IS projects is based on the level of certainty that they will pay off. Thus, we ask how uncertainty and motivation influence the intent of small firms to adopt IOS over the internet?

This paper introduces the uncertainty perspective as pivotal to the IOS adoption decision in small businesses. The uncertainty perspective was first suggested by McMullen and Shepherd (2006) and further developed by Meijer et al. (2006, 2007). We adopt their theoretical insights to show that the uncertainty perspective lends valuable insights to explain decision dithering in technology adoption involving supply-chain IT integration.

The rest of the article is organized as follows: it starts with a background review of the theoretical underpinnings of technology adoption and, more specifically, the uncertainty perspective; then the proposed research model and hypotheses are presented, followed by the methodology used, data collection methods and the results; the last section discusses the essential findings and implications.

THEORY

THE UNCERTAINTY PERSPECTIVE

Bensaou and Venkatraman (1996) suggested a framework covering uncertainties in information systems on three levels: environment, partnership, and task. Regardless of this early contribution, the concept of uncertainty has remained underexplored in information systems research. For example, differences in motivation, attitude, or risk propensity (Douglas & Shepherd, 2000; Knight, 1921; McMullen & Shepherd, 2006; Schumpeter, 1934) define the level to which individuals are willing to bear uncertainty and discriminate between those who decide to act and those who do not. An

individual must ultimately act to adopt technology, and intention precedes action involving knowledge and motivation (McMullen & Shepherd, 2006). Sutton (1998) performed meta-analyses of research showing that studies using the Theory of Reasoned Action and the Theory of Planned Behavior (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) explain, on average, between 40% and 50% of the variance in intention, and between 19% and 38% of the variance in action. Therefore, we focus on intention as an antecedent to action, given the high transferability between intention and action.

Uncertainty, Decision Dithering, and Technology Adoption

In parallel with Meijer et al. (2007), we propose perceived uncertainty as an antecedent to decision dithering in technology adoption. There are several sources of uncertainties possible such as technological uncertainty, resources uncertainty, competitive uncertainty, consumer uncertainty, supplier uncertainty, and political uncertainty (Clark, 1985; Duncan, 1972; Jauch & Kraft, 1986; Meijer et al., 2007; Milliken, 1987) and in the context of the modern business environment (Scupola, 2003), we can add knowledge uncertainty, relational uncertainty, and security uncertainty. Song and Montoya-Weiss (2001) argued that uncertainty should be studied with specific components to ascribe effects appropriately. Given the relevance of resource allocation in small businesses, we focus on resources- and knowledge uncertainty as two key internal sources of uncertainty. Since there is an accelerating rate of IOS technologies on offer in the market, small businesses face both relational and security uncertainties, i.e., what technology standard will be adopted by business partners, and what technology is secure and least likely to tax a small business's financial and human resources?

Adopting an emerging technology depends on whether the decision-maker is motivated enough to act despite the uncertainty he or she perceives (McMullen & Shepherd, 2006; Meijer et al., 2006, 2007). Thus, action depends on motivation and outweighs the perceived uncertainty (Meijer et al., 2007). Thus, motivation can be understood as rationalization behind a motive or motives for intent (Smith et al., 2007). According to Chwelos et al. (2001), motivation divides into internal and external origins. These two sources of motivation encapsulate the three base motives described by Schermerhorn (1975): resource scarcity (i.e., to seek efficiency), value expectancy (i.e., to seek growth), and coercive pressure (i.e., reaction to competition and demand from business partners).

Thus, as Meijer et al. (2007) argue, to understand the relationship between action (intent in our case) and uncertainty, we must also understand the relationship between uncertainty and motivation. We extend their ideas to show that action is also central to technology adoption, and the different elements of action apply, such as knowledge (perceived uncertainty) (Chong & Bai, 2014), motivation (uncertainty forbearance), and stimulus. From these elements stem beliefs qualified by the uncertainty that forms doubts, preventing action, and when examining action, both knowledge and motivation must be considered concurrently (McMullen & Shepherd, 2006). The following sections will explain each of the theoretical components in more detail.

Research Model and Hypotheses

Based on the extant literature, a theoretical model is suggested where intent to adopt IOS is determined by three primary constructs: perceived uncertainty, IT readiness, and motivation. Perceived uncertainty and motivation are each influenced by sub-constructs. All the constructs in the measurement model (outer model) were reflective and accounted for observed variances. A reflective construct implies that the observed indicators are caused by an underlying construct (Fornell & Bookstein, 1982). Unlike the measurement model dealing with the constructs and their indicators, the structural model (inner model) deals with the relations between the constructs. The structural model is formative because the endogenous constructs influence the exogenous constructs.

Perceived Uncertainty

In the following section, the perceived uncertainty construct is separated into four sub-constructs: security, resources, knowledge, and relations.

Security uncertainty is frequently reported as an essential consideration in IOS (Chappell & Feindt, 2000; Grandon & Pearson, 2004; Segev et al., 1997; Thong, 1999; Tuunainen, 1999). In handling messages between Internet Service Providers (ISPs), the chance of tampering with a message is quite low, but the possibility exists. The internet's perceived openness and phishing, viruses, and other malware may inhibit small firms from adopting IOS. Moreover, electronic delivery mistakes of messages due to security breaches can have severe consequences if the broken information stream interferes with the physical logistics stream. SMEs usually have a low equity ratio and fewer resources and are therefore more vulnerable to security risks than large businesses (Altman et al., 2010). Hence, whether or not the internet is suited for the delivery of transactions depends on the perceived risk of data loss and customer reaction if things go wrong.

Resources uncertainty encompasses both financial and human origins. For instance, the required human effort may, according to Beckinsale et al. (2006), play a role in decisions to adopt IOS over the internet in small businesses. The effort is measured in time to implement and the required changes to internal processes (Im et al., 2008; Poon & Swatman, 1999). Ascertaining this point, Tetard and Collan (2009) found that people, in general, may be inclined to choose solutions of least effort in the context of systems. Small firms do not have the resources of larger firms, and often the owner is involved in every project in the firm. Opportunity costs measured in time and money become a paramount concern in a small firm. Financial resources tend to be limited, so the implementation cost of IOS has frequently been reported as a barrier in the adoption decision (Chappell & Feindt, 2000; Fuller-Love, 2006; Nguyen, 2009; Senn, 1998; Tuunainen, 1999). Consequently, small businesses are particularly affected due to resource outlays like buying software and training staff (Caldeira & Ward, 2003; Kuan & Chau, 2001).

Knowledge uncertainty encompasses several potential sources: lack of information, uncertainty about results, distrust of changes, and technical complexity. The potential emergence of new technologies increases uncertainty as something better, cheaper, or more suitable might soon appear (Segev et al., 1997; Williams et al., 1998). SME managers may wait for the next "big thing" or wait until a vital customer demands the IOS rather than getting locked into a technology that may not bring the expected benefits (Chappell & Feindt, 2000; Segev et al., 1997; Tuunainen, 1999). In the context of limited resources, the cost of mistakes can be high (Bell, 1982; Fishburn, 1982; Loomes & Sugden, 1982; Quiggin, 1994; Sugden, 1993), and small businesses may not have the time or financial resources to seek knowledge that helps sort out many technology choices. Thus, facing many choices, a small business may fall back on the "better to wait and see what happens" dithering pattern (Irons & Hepburn, 2007).

Relational uncertainty is associated with a lack of demand, trust, and partner resistance. An IOS is often implemented in small firms only if a large customer demands such a system, which may even dictate the software and network that has to be used (Young et al., 1999). Large manufacturers like Ford and General Motors and retailers like Walmart are examples of companies that have made such *demands* on trading partners (Tarofder et al., 2017; Young et al., 1999). However, it can also be the other way around, where there is no direct pressure from focal firms.

Trust is an important factor in any relational network (Qu & Yang, 2015), generally seen as a prerequisite for efficient business processes. Trust has been identified as an essential component in partnerships, strategic alliances, and networks of firms (Davey & Powers, 2016). Thus lack of trust in the relational network can have detrimental effects on the intent to adopt IOS due to reluctance to exchange information and knowledge (Rahim & Kurnia, 2004). Another element of relational uncertainty is *resistance* from trading partners to take up a common IOS standard. Institutionalized practices are proven ways of accomplishing tasks and are difficult to change, i.e., employees will question why

to replace manual processes or older systems that work well and have taken years to refine (Nov & Ye, 2008). Furthermore, each trading partner is embedded in other trading relationships that may involve competitors, potentially influencing relational uncertainty (Radhakrishnan et al., 2018) and trust. In other words, the firm needs to perceive relational changes favorably to adopt IOS technologies. The early adopters especially receive a limited initial benefit if the IOS has slow penetration rates in the relations network. Thus,

H1a: Perceived uncertainty has a negative relationship with intent to adopt IOS in small businesses

H1b: Security uncertainty has a positive relationship with perceived uncertainty

H1c: Resources uncertainty has a positive relationship with perceived uncertainty

H1d: Knowledge uncertainty has a positive relationship with perceived uncertainty

H1e: Relational uncertainty has a positive relationship with perceived uncertainty

Motivation

The motivation construct comprises two sub-constructs: perceived internal- and external benefits. Internal benefits of IOS can be numerous, such as cost savings, employee efficiency, inventory reduction, shorter delivery times, and improved customer service. External benefits include better cooperation with suppliers, faster time to market, better access to business partners and information, and increased ability to promote new and adapted products and services. If a small business does not expect the IOS to provide internal and external benefits to the business or culminate in business growth (Beckinsale et al., 2006), the adoption rate is bound to be low.

An internal benefit such as efficiency has historically been associated with IOS implementation through a faster and more accurate flow of information (Chappell & Feindt, 2000; Iacovou et al., 1995; Murphy & Daley, 1996), leading to operational cost savings, reduced paperwork, and reduced data re-entry requirements and error rates (Chwelos et al., 2001). Likewise, indirect efficiency benefits emerge from using IOS, such as improved customer service and business process improvements (Davenport & Short, 1990; Hammer & Stanton, 1999). These internal sources of motivation have a positive relationship with perceived benefits and, therefore, a positive relationship with the intent to adopt IOS.

Demand from powerful downstream partners plays a role in the adoption decision (Chappell & Feindt, 2000; Iacovou et al., 1995; Soliman & Janz, 2004; Teo et al., 2003; Williams et al., 1998; Young et al., 1999). Research shows that coercive demand from a key partner is often the only reason small firms engage in IOS over the Internet (Iacovou et al., 1995). Tuunainen (1999), researching the automotive industry and IOS adoption among SMEs, reported that IOS was perceived mainly as means for survival and that upstream firms tend to wait for more significant partners to demand IOS. Based on the evidence, both internal and external benefits should positively influence motivation and, therefore, positive relationship with the intent to adopt. Thus,

H2a: Motivation has a positive relationship with the intent to adopt IOS among SMEs

H2b: Perceived internal benefits have a positive relationship with motivation

H2c: Perceived external benefits have a positive relationship with motivation

Lack of IT readiness, such as expertise and infrastructure, and ability to resolve technical issues inhibits information system initiatives in small businesses (Teo et al., 2006). Implementing IOS over the internet requires particular technical knowhow that might be difficult to overcome for smaller firms without an IT department. Many small businesses do B2C commerce over the internet and have made the first steps towards B2B e-commerce (Al-Somali et al., 2015; Kurnia, 2008; Kurnia et al., 2015) even if they do not have full IOS capabilities (Legner, 2008). However, a lack of technical

competence, such as IT infrastructure, hinders IOS adoption (Lin, 2006) but a rising degree of IT readiness lowers the barrier of interoperability with other systems and firms (Hong & Zhu, 2006). Based on the above, we hypothesize that the intensity of IT use and the level of e-commerce readiness positively affect the intent to implement IOS over the internet in small businesses. Thus,

H3: IT readiness has a positive relationship with the intent to adopt IOS among small businesses.

To sum up, this section has argued that resources, knowledge, relations, and security constitute perceived uncertainties influencing IOS adoption negatively over the internet, while positive assumptions about internal and external benefits, in combination with the degree of IT readiness, motivate the intent of the small business to adopt IOS over the internet.

RESEARCH METHODOLOGY

SAMPLING DESIGN

Three commonly used criteria for defining SMEs are the number of employees, annual revenues, and fixed assets (Thong, 1999). In this research, European SME firms from any industry were included based on annual revenue criteria of less than twenty million Euros. We adopted the EU definition of small firms as firms with a headcount of less than 50 and medium-sized firms with less than 250 employees. Since all our sample firms had fewer than 100 employees and the average was less than 50, we classify our research as a small business study.

The total questionnaires analyzed were 139 from a larger sample of Dutch businesses. The sample firms used in this analysis cover two groups: 1) firms that claimed intent to implement IOS over the internet within five years and firms that considered the possibility of adopting IOS seriously; and 2) firms that had no intention of implementing IOS over the internet but had considered IOS seriously. Some of the firms in the sample were already running legacy non-internet-based IOS.

INSTRUMENT AND CONSTRUCT DEVELOPMENT

The study was a pilot, where the instrument was developed based on a literature review and first tested on a small sample extracted from the full mailing list of SME firms. The test helped to revise and focus the instrument that was then sent to the full mailing list of firms.

We measure three primary constructs in this study (perceived uncertainty, IT readiness, motivation) and six sub-constructs (security uncertainty, resources uncertainty, knowledge uncertainty, relational uncertainty, perceived internal benefits, and perceived external benefits). The dependent variable was the intention to adopt IOS over the internet.

The dependent variable was a single item dichotomous measure, 0 = no intention to adopt IOS within five years, and 1 = intention to adopt IOS within five years. The number of respondents in each group was 78 and 61, respectively. Perceived uncertainty echoes prior studies that have typically covered two or more dimensions of this construct (Chappell & Feindt, 2000; Harland et al., 2007; Iacovou et al., 1995; Im et al., 2008; Tuunainen, 1999). The construct was measured using five items on a five-point Likert-type scale: lack of clear information; trust in cooperation with trading partners; the uncertainty of improving company results; distrust of changes; and technical complexity. The measure has good statistical reliability traits based on the composite reliability score. It had four sub-constructs: security uncertainty (C.R. = 0.89), resources uncertainty (C.R. = 0.86), knowledge uncertainty (C.R. = 0.80), and relational uncertainty (C.R. = 0.80).

Motivation is a construct reflecting a desire to act, commonly included in previous research (Chwelos et al., 2001; Iacovou et al., 1995; Saunders & Clark, 1992) and measured in our research using two sub-constructs, namely perceived internal benefits and perceived external benefits. The former reflected operating cost benefits, higher employee efficiency, lower inventory, shorter delivery times,

and better and faster customer service. The items were measured using a five-point Likert-type scale. The sub-constructs had good internal consistency measured as composite reliability (Feldt & Brennan, 1989): perceived external benefits (C.R. = 0.88) and perceived internal benefits (C.R. = 0.90). The latter construct was reflected in better cooperation with suppliers, faster time to market, expanding trading partners, better access to trading partners' information, and the ability to offer new and adapted products and services.

IT readiness is an integral part of the IS adoption model. The construct was measured using two items, level of IT use, measured on a five-point scale, 1 = no IT integration, to 5 = very high IT integration; and level of e-commerce use, measured on a five-point scale, 1 = no e-commerce integration, to 5 = very high e-commerce integration.

Altogether, the statistics for constructs provided evidence that the measures were reasonable and consistent.

Control Variables

This study used two control variables: firm size and firm age. Young firms search for viable business models that are sustainable and grow the firm, while older firms have found ways to sustain themselves. Hence, similar size young and old firms may differ substantially in their characteristics and possess different resources to implement Internet IOS. For this reason, we specify age and size as control variables.

Firm size was measured using the number of employees (Chappell & Feindt, 2000; Palvia & Palvia, 1999; Thong, 1999). The more employees a firm has, the more likely the firm is to have the necessary staffing to implement IOS over the internet. All the firms in the sample had less than 100 employees, with the average falling between categories 4 (5-9 employees) and 5 (10-19 employees).

Coad et al. (2013) showed that older firms are likelier to turn sales growth into profits through better productivity. With firm age, business operations become routine and stable (liability of newness diminishing), freeing time for new projects, even in firms with few employees. Firm age was used as a control variable and contained five age categories, 1 = less than 3 years, to 5 = more than 21 years.

Data Analysis and Results

We use structural equation modeling (PLS-SEM) (Ringle et al., 2005) to analyze the data. The PLS-SEM technique does not assume that variables have been measured free of errors (Fornell & Bookstein, 1982), and it considers all path coefficients simultaneously. PLS-SEM is particularly well suited to analyze indirect, direct, spurious, and several individual item loadings in a specified model, as is our case. PLS offers numerous reliability and validity statistics and often reveals associations that might not appear in conventional regression models or covariance-based SEM models (Wilcox, 1998). To validate the models, we used an instrument validation (Chin et al., 2003) to assess if common method bias was present (Podsakoff et al., 2003), and finally, pseudo goodness of fit test was carried out (Tenenhaus et al., 2005).

PLS-SEM is sensitive to missing values (mean value replacement or case-wise deletion), as suggested by Hair et al. (2013). However, the dataset was almost complete, and no variable had more than 1 percent missing values, thus, this was not a problem in the analysis. Although PLS is frequently considered suitable for small sample size studies, the sample size used in the analysis was 139 cases, meeting general assumptions about sample size requirements for regression analysis.

Instrument Validation

The correlations for first-order constructs and control variables are shown in Table 1, and for second-order constructs and control variables in Table 2. We analyzed the measurement model for average variance extracted, reliability, convergent validity, and discriminant validity (see Table 3). We also

analyzed the instrument for common method bias (see Appendix A). Table 3 lists the constructs, the number of items associated with each construct, average variance extracted, composite reliabilities, and Cronbach's Alpha. Item loadings are also shown in Table 3. Internal consistency, measured through factor loadings, was, in all cases, above the recommended cut-off of 0.50 (range from 0.56 to 0.94) (Tabachnick & Fidell, 2000). The composite scale reliability matched or exceeded the recommended minimum of 0.70 (range 0.80 to 0.92), and Cronbach's Alpha showed results ranging from 0.51 to 0.89, with three constructs below the cut-off of 0.70. Although PLS SEM does not assume normality in the data (Goodhue et al., 2012), we tested all variables for normality and no serious violations were detected.

The composite reliability assesses the indicator loadings while Cronbach's alpha evaluates the indicator variances and covariances. For this reason, Cronbach's alpha is inconsistent as an estimate of PLS construct scores. In reaction to this problem, Chin (1998a) suggested the composite reliability measure based on the work of Heise and Bohrnstedt (1970) as a more appropriate measure of reliability in PLS (Dijkstra & Henseler, 2015). Based on the above, we consider the internal consistency measures acceptable despite the Cronbach's Alpha scores.

Convergent validity (AVE) (see Table 3) exceeded or met the accepted minimum (0.50) cut-off in all cases except for the second order construct perceived uncertainty (range 0.36 to 0.73) (Fornell & Larcker, 1981). To test discriminant validity, we calculated the square root of AVE (see Tables 1 and 2, off-diagonal of the matrix) (Carmines & Zeller, 1979; Fornell & Larcker, 1981; Hulland, 1999) and cross-loadings (Chin, 1998b; Gefen et al., 2000). Discriminant validity is assumed to exist if the square root of AVE for a particular latent variable exceeds the correlation of that latent and any other latent variable. In all cases, the root of AVE was considerably higher than the bivariate correlations between the latent variables (range 0.60 to 0.85). The cross-loadings test showed that no manifest variables loaded higher on any other latent variable than their associated latent variable. These two tests demonstrated strong discriminant validity.

Table 1. Correlations for 1st Order Constructs[1] (N=139)

	1	2	3	4	5	6	7	8	9
1. Perceived external benefits	(0.77)								
2. Perceived internal benefits	0.649	(0.79)							
3. Knowledge uncertainty	0.180	0.078	(0.71)						
4. Relational uncertainty	0.090	0.028	0.499	(0.76)					
5. Resources uncertainty	0.312	0.090	0.541	0.360	(0.82)				
6. Security uncertainty	0.372	0.243	0.457	0.404	0.406	(0.85)			
7. Intent to use internet-IOS	0.237	0.343	-0.119	-0.095	-0.016	0.010	1		
8. Firm size	0.127	0.267	0.168	0.046	0.089	0.142	0.211	1	
9. Firm age	0.380	0.009	-0.059	0.141	-0.004	0.064	0.122	0.167	1

[1] Note: Diagonal elements in parentheses are the square root of average variance extracted (AVE) (Hulland, 1999).

Table 2. Correlations for 2nd Order Constructs[1] (N=139)

	1	2	3	4	5	6
1. IT readiness	(0.82)					
2. Motivation	0.135	(0.71)				
3. Uncertainty	-0.080	0.256	(0.60)			
4. Intent to use internet-IOS	0.313	0.325	-0.070	1		
5. Firm size	0.114	0.222	0.152	0.211	1	
6. Firm age	0.147	-0.034	-0.029	0.122	0.167	1

[1] Note: Diagonal elements in parentheses are the square root of average variance extracted (AVE) (Hulland, 1999).

Table 3. Construct loadings, validity, consistency, and t-statistic[1,2]

	Loading	t-stat	AVE	CR.	CA.
Perceived uncertainty			0.36	.88	.85
Resources uncertainty			0.67	.86	.75
Ru1	0.734***	14.840			
Ru2	0.893***	38.516			
Ru3	0.830***	29.385			
Knowledge uncertainty			0.51	.80	.67
Ku1	0.772***	18.781			
Ku2	0.666***	8.730			
Ku3	0.708***	15.992			
Ku4	0.691***	11.212			
Relational uncertainty			0.58	.80	.63
Lu1	0.841***	22.811			
Lu2	0.844***	27.926			
Lu3	0.559***	4.362			
Security uncertainty			0.73	.89	.82
Su1	0.885***	49.763			
Su2	0.874***	30.179			
Su3	0.806***	20.905			
Motivation			0.51	.92	.89
Perceived external benefits			0.60	.88	.83
Pu1	0.725***	13.043			
Pu2	0.780***	22.394			
Pu3	0.797***	23.356			
Pu4	0.825***	26.522			
Pu5	0.742***	17.634			

	Loading	t-stat	AVE	CR.	CA.
Perceived internal benefits			0.63	.90	.85
Ib1	0.742***	12.663			
Ib2	0.800***	21.026			
Ib3	0.766***	18.404			
Ib4	0.841***	32.989			
Ib5	0.823***	26.957			
It-Readiness			0.67	.80	.51
Pe1	0.814***	5.237			
Pe2	0.822***	4.919			

[1]Significance of estimators was calculated by using Bootstrapping (150 cases and 500 samples).
[2] Note: *, **, *** coefficients significant at $p<0.05$, $p<0.01$, $p<0.001$, respectively.

COMMON METHOD BIAS

Obtaining the measures of the predictors and the criteria variable from the same source is subject to cause common method bias (Podsakoff et al., 2003). Our study obtained the dependent variable from the same instrument as the construct indicators. Thus, we had reason to believe that constructs derived from the same block of questions in the instrument might be subject to common method bias. To see if this was the case, we followed a procedure suggested by Liang et al. (2007) for the partial least squares method based on a common method factor (Podsakoff et al., 2003; Williams et al., 2003).

The common method includes all the principal indicators of the model constructs. Then we specified separate constructs for all indicators with paths to the method factor and calculated the variance explained for both the substantive and the method loadings (see Appendix B). The average variance explained by the substantive indicators was 0.79, and the average variance by the method indicators was -0.003. Four out of 25 method factor loadings were significant. However, the ratio between the method and the substantive loadings and variance was very high, 254:1 and 97:1, respectively. The small magnitude and insignificance of the method variance allow us to conclude that method is not a concern for this study.

RESEARCH MODEL

Tenenhaus et al. (2005) developed a global fit measure applicable to PLS path modeling, defined as the geometric mean of the average communality and average R^2 for the endogenous constructs. Wetzels et al. (2009) propose baseline values for GoF; small = 0.1, medium = 0.25, large = 0.36. The model achieved a GoF value of 0.48, which exceeds the base value for large effect sizes, indicating a good model performance.

HYPOTHESES TESTING

The results are reported in Table 4 and Figure 1 and show that all the hypothesized relationships are confirmed. The following section will explain the results in detail.

Table 4. Path Coefficients[1,2,3]

Hyp.	Path	Coeff.	SE.
H1a	Per. uncertainty -> intent to use IOS	-0.198**	0.069
H1b	Security uncertainty-> per. pncert.	0.340***	0.026
H1c	Resources uncertainty -> per. uncert.	0.322***	0.025
H1d	Knowledge uncertainty -> per. uncert.	0.362***	0.025
H1e	Relational uncertainty -> per. uncert.	0.281***	0.026
H2a	Motivation -> intent to use IOS	0.332***	0.068
H2b	Perceived internal benefits -> motiv.	0.580***	0.024
H2c	Perceived external benefits -> motiv.	0.521***	0.024
H3	IT readiness -> intent to use IOS	0.245***	0.073
	Firm age -> intent to use IOS	0.169*	0.066
	Firm size -> intent to use IOS	0.087	0.077
	Model R^2	0.303	
	Pseudo model GoF	0.490	

[1]Significance of estimators was calculated by using Bootstrapping (150 cases and 500 samples).
[2] Note: *, **,* ** coefficients significant at $p<0.05$, $p<0.01$, $p<0.001$, respectively.
[3] Goodness of fit measure (see Tenenhaus et al., 2005).

The results supported hypotheses H1a ($\beta = -.198$, $p < .01$); perceived uncertainty has a negative relationship with the intention to adopt IOS. The results showed that security uncertainty (H1b: $\beta = .340$, $p < .001$), resources uncertainty (H1c: $\beta = .322$, $p < .001$), knowledge uncertainty (H1d: $\beta = .362$, $p < .001$), and relational uncertainty (H1e: $\beta = .281$, $p < .001$) are all significantly related to perceived uncertainty.

The results supported hypotheses H2a ($\beta = .332$, $p < .001$), stating that motivation was positively related to the intention to adopt IOS. The sub-constructs were all significantly related to motivation and supported all hypotheses: hypotheses H2b ($\beta = .580$, $p < .001$), perceived internal benefits have a positive relationship with motivation, and hypotheses H2c ($\beta = .521$, $p < .001$) perceived external benefits have a positive relationship with motivation.

The results indicate that IT readiness (H3: $\beta = .245$, $p < .001$) was significantly related to the intention to adopt IOS.

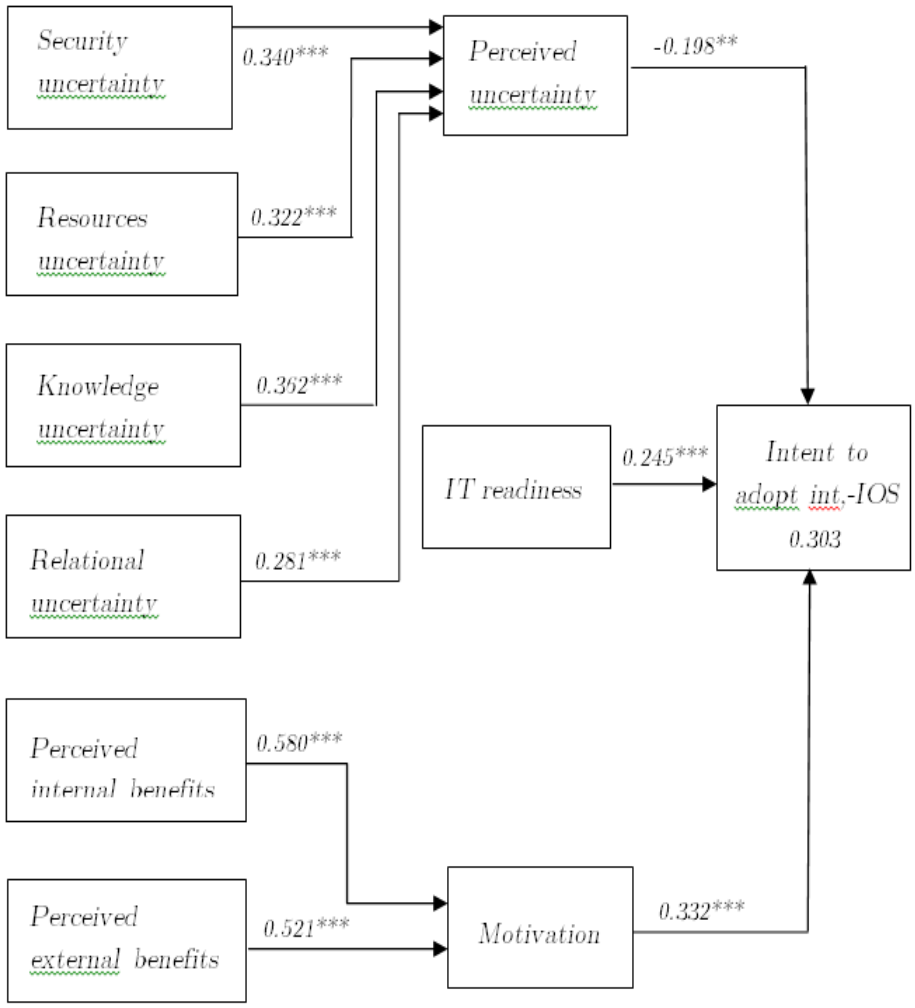

Figure 1. The model results

Note: *, **, *** path significant at p<0.05, p<0.01, p<0.001, respectively.

As can be seen from Table 4, we enter two control variables into the model. Firm age had significant positive relationship with intent to adopt IOS (β = .169, p < .01), while firm size had non-significant relationship with intent to adopt IOS (β = .087, n.s.).

DISCUSSION AND CONCLUSION

Our study is consistent with the uncertainty perspective: internal and external sources of uncertainty and motivation do indeed influence intent to adopt IOS. In what follows, we will discuss the broader implications of the findings.

Starting with internal sources of perceived uncertainty, we found that small business managers perceive internal factors such as resources and knowledge as significant sources of uncertainty when considering IOS over the internet. The resources construct was composed of time, investment, and communication costs, in line with our previous argument that small businesses have a generalist central figure at the helm who is heavily involved with the implementation of projects and is concerned about resources. Another construct knowledge was also significant, indicating that small business

managers lack information, are not sure about the impact on results, feel distrust about changes, and worry about the technical complexity of IOS solutions over the internet.

External sources of perceived uncertainties, such as security and relations with the extant business partners, also played a significant role. The significance of the security construct indicates that managers are concerned about the confidentiality of information, lack trust in the safety of the internet, and feel there is a lack of legal standards governing exchanges. The relational construct indicates that managers are concerned about resistance from trading partners, trust in cooperating with trading partners, and lack of demand by partners for IOS over the Internet.

Any effort to win over small business managers to IOS over the internet must address these factors convincingly both at the product and campaign levels through clear, accessible information, by demonstrating security provisions, low-cost products, and simple interfaces, as well as system adaptability to existing provisions in the IOS Internet network. Otherwise, potential substitute technologies incentivize to wait instead of jumping on the bandwagon.

SME managers are especially concerned about their companies' efficiency and growth (Beckinsale et al., 2006), and the findings support that premise strongly. If SME managers see that IOS can support increased efficiency and growth, they are more likely to view it favorably. We see this as a source of motivation from a firm's proactive and strategic internal orientation and the external relations considerations essential to building effective supply chains and customer relationships.

Firm age as control was significant but not firm size. This result contrasts with previous research using size as a control variable but was in line with research that included firm age (i.e., Coad et al., 2013); this can be interpreted in the way that with age, firms go beyond the liability of newness problem and are likely to have more slack resources due to more stable operations.

Theoretical Implications

The theoretical underpinning of the research was the technology adoption model, with the main contribution being a new perspective through a theoretical extension using uncertainty theory. Thus, the overriding question guiding our research was how perceived uncertainties and motivation influence the intent to adopt IOS technologies over the internet. Previous research on adoption modeling is deeply rooted in the reasoned action and the planned behavior theories but has primarily neglected uncertainties and the interaction of uncertainties and motivation to explain the intention and eventual action. In this research, we used the uncertainty perspective to demonstrate the importance of uncertainties in adoption modeling and extended prior work by identifying significant sources and influences on technology adoption.

The analysis supports the theoretical work of Meijer et al. (2007) and McMullen and Shepherd (2006), who stated that a particular action (intention in our research) is indeed dependent on the intensity of the relationship with motivation (perceived benefits) and perceived uncertainty. The intent will occur if motivation exceeds perceived uncertainty. However, upon testing, we could not show any significant direct relationship between the uncertainty and the motivation constructs, allowing us to state that the constructs appear independent: this means there is no trade-off between uncertainty and motivation as both can coexist and act independently on intent to adopt the technology. In other words, intent to adopt might exist if both motivation and uncertainty are high, but in all probability, not if uncertainty is high and motivation low.

Finally, we show how various negative and positive internal and external factors act as sources of perceived uncertainty and motivation, providing deeper insights into the mechanisms of the uncertainty perspective applied to the technology adoption problem.

This research used IT readiness as a construct, composed of IT and e-commerce components. Since most small firms do not have departments or dedicated personnel performing the IS function, IS in

large firms has little resemblance with that of small firms, making the combination of IT-use and e-commerce-use an important construct as to the ability of small firms to adopt IOS over the internet.

The openness of the internet may have reduced the cost barrier of IOS. However, in turn, managers of small businesses perceive the combination of internet security, need from business partners, needed resources, and knowledge of IOS and its impact on the business as an uncertainty having a negative influence on intent to adopt. Thus, perceived uncertainty is an essential but under-explored perspective when modeling technology adoption in information systems. Given the increasing interest in understanding and steering technology adoption in various social and economic contexts, scholars, policymakers, and small firms may benefit from understanding the uncertainty perspective when dealing with the technology adoption question.

Limitations and Future Research

The uncertainty perspective is a recent theoretical direction in the adoption of innovations and entrepreneurship and has still not been tested extensively empirically, especially not in the context of technology adoption. Certain aspects of the perspective, such as assumed inter-linkages between uncertainties and motivation, were not evident in our results and needs further investigation.

Conclusion

The results show that significant uncertainties influence small firms' technology adoption decisions. In other words, small firms are concerned about adopting a technology prematurely, as reflected clearly in our model. When perceived uncertainty is high, managers of SMEs become risk aversive. Thus, any effort to win them over to IOS over the internet must convincingly address the perceived uncertainty factor. Regardless of a strong perception of benefits associated with IOS solutions, these must encompass flexible and upgradeable technologies so that potential substitute technologies do not create an incentive for users to wait and mitigate perceived uncertainties by avoidance. This tendency may be ameliorated by perceived uncertainty even if both substantial perceived- benefit and pressure exist.

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APPENDIX A. QUESTIONNAIRE ITEMS

Variable	Item
	Knowledge uncertainty
Ku1	Lack of clear information
Ku2	Uncertainty about improvement of company results
Ku3	Distrust of changes
Ku4	Technical complexity
	Resources uncertainty
Ru1	Lack of time for implementation
Ru2	High investment costs
Ru3	High communication costs
	Relational uncertainty
Lu1	Resistance from trading partners
Lu2	Trust in cooperation with trading partners
Lu3	Lack of demand from trading partners
	Security uncertainty
Su1	Confidentiality of information
Su2	Lack of trust in the safety of internet
Su3	Lack of legal standards
	Perceived external benefits
Pu1	Better cooperation with suppliers
Pu2	Faster time to market
Pu3	Expanding the number of trading partners
Pu4	Better access to the information of trading partners
Pu5	Offer new and adapted products and services
	Perceived internal benefits
Ib1	Operational cost savings
Ib2	Higher efficiency of employees
Ib3	Lower inventory
Ib4	Shorter delivery times
Ib5	Better and faster customer service
	IT Readiness
Pe1	Level of IT use
Pe2	Level of e-commerce use

APPENDIX B. COMMON METHOD BIAS ANALYSIS

	Subst. loading	$R1^2$	t	Method loading	$R2^2$	t
IT readiness						
Pe1	0.817	0.667	32.955	0.035	0.001	0.688
Pe2	0.819	0.671	34.251	-0.035	0.001	0.688
Relational uncertainty						
Lu1	0.845	0.714	17.575	-0.003	0.000	0.048
Lu2	0.722	0.521	11.378	0.162	0.026	1.958
Lu3	0.734	0.539	5.455	-0.227	0.052	2.124
Security uncertainty						
Su1	0.986	0.972	21.191	-0.137	0.019	2.312
Su2	0.794	0.630	9.515	0.017	0.000	0.197
Su3	0.787	0.619	14.692	0.118	0.014	1.843
Resources uncertainty						
Ru1	0.817	0.667	18.950	-0.004	0.000	0.058
Ru2	0.814	0.663	17.667	0.004	0.000	0.058
Ru3	0.830	0.679	19.272	0.005	0.000	0.057
Knowledge uncertainty						
Ku1	0.722	0.521	9.449	0.082	0.007	0.932
Ku2	0.657	0.432	5.158	0.017	0.000	0.143
Ku3	0.782	0.612	9.029	-0.098	0.010	1.036
Ku4	0.681	0.464	5.779	-0.01	0.000	0.091
Perceived ex. benefits						
Pu1	0.701	0.491	9.703	0.029	0.001	0.395
Pu2	0.809	0.654	14.994	-0.059	0.003	0.939
Pu3	0.819	0.671	17.918	-0.026	0.001	0.465
Pu4	0.789	0.623	14.766	0.064	0.004	1.096
Pu5	0.753	0.567	11.349	-0.009	0.000	0.122
Perceived in. benefits						
Ib1	0.852	0.726	12.031	-0.064	0.004	0.735
Ib2	0.817	0.667	12.664	0.018	0.000	0.209
Ib3	0.740	0.548	7.650	0.030	0.001	0.294
Ib4	0.717	0.514	8.817	0.075	0.006	0.801
Ib5	0.847	0.717	13.900	-0.053	0.003	0.731
Average loading	0.786	0.622		-0.003	0.006	
Ratio avg. loading R1 to R2	254:1					
Ratio avg. variance $R1^2$ to $R2^2$	97:1					

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