Stepwise innovation adoption: a neglected concept in innovation research

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Abstract: Most innovation researchers tend to consider innovation adoption as a binary process, implying that companies have either adopted an innovation or not. In this paper we focus on e-commerce as an innovation that can be adopted stepwise. We distinguish between two levels of e-commerce, basic and advanced. Following Rogers' (1995) innovation adoption model, we investigate the differences between companies with regard to their knowledge, perceived potential value, implementation and satisfaction with e-commerce. In a field study involving 127 companies, we consistently find higher scores for companies at the advanced level, even when controlling for the impact of the intention to further adopt e-commerce and various contextual factors. Interestingly, we also find significant, negative interaction effects between adoption level and adoption intention. Due to the magnitude of these effects, the interaction effects tend to cancel out the additional effect of adoption intention for companies at the advanced level.

Keywords: adoption; adoption level; e-commerce; innovation; stepwise innovation.

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1 Introduction

Innovation adoption studies usually consider the adoption of an innovation as a binary process, i.e. a company has adopted an innovation or a company has not (yet) adopted it. From a management point of view, this perspective is much less attractive. Of course, managers are eager to adopt innovations that could enhance the growth and profit potential of their firm but, at the same time, they purposely intend to minimise the associated risks. After all, what once was perceived as an attractive opportunity may end up as a corporate 'black hole', consuming valuable resources without producing a measurable pay off. Several implementation strategies are available for managers seeking to minimise risk. Test markets are recommended for new products and services and pilot projects for process innovations (e.g. Drucker, 2001; Tidd et al., 2001). Another way to minimise innovation risks is to implement the innovation stepwise. This may not be possible for all innovations but it is for many complex or modular innovations. Such innovations can be considered as 'multi-level phenomena' and their adoption involves more levels than simply 'did not implement' and 'did implement'. Surprisingly, in innovation research this distinction between multiple adoption levels has only rarely been made.

There are a few studies that have considered innovation adoption as a multi-level phenomenon. For example, Frambach and Schillewaert (2002) developed a multi-level framework of the determinants of organisational innovation adoption. The two adoption levels they distinguish are adoption at the organisational level and at the level of the individual within an organisation. Their levels refer to the question 'who is adopting?' but not to 'what is adopted?' The latter approach is taken by Daniel et al. (2002), who studied the adoption of e-commerce by SMEs in the UK. They found four clusters of adoption that seem to represent sequential levels at which firms can adopt e-commerce. Recently, Lee and Grewal (2004) investigated the impact on firm performance of adopting the internet as a communications channel or as a sales channel by traditional store-based retailers. They found a significant effect only for communications (i.e. the low adoption level) but not for sales (i.e. the high adoption level).

Many studies that considered innovation adoption as a binary process have focused on the determinants of the decision to adopt (e.g. Dholakia and Kshetri, 2004; Luchetti and Sterlacchini, 2004; Mehrtens et al., 2001; Thong, 1999). Do the firms that have adopted, or that are more likely to adopt, have more knowledge about the innovation? Do they consider the innovation as having a larger relative advantage compared to the current product or technology? Do they perceive fewer threats in adopting the innovation (e.g. less organisational resistance, fewer monetary costs or fewer cannibalisation effects)?

In this study we link both streams of research. More precisely, we investigate whether considering innovation adoption as a multi-level phenomenon instead of a binary process affects the determinants of innovation adoption. For example, several studies have shown that having more knowledge about an innovation increases the likelihood of innovation adoption (e.g. Luchetti and Sterlacchini, 2004; Southern and Tilley, 2000; Thong, 1999). We investigate the differences in the level of knowledge between companies that have adopted an innovation at a basic level compared with companies that have adopted the innovation at a more advanced level. Based on the well-known Rogers (1995) innovation adoption model, we study differences with regard to the various stages in the innovation-decision process, i.e. knowledge, persuasion, implementation and confirmation.

Although the Rogers model has been criticised (e.g. Biemans, 1992), the main variables of this model are still widely used in innovation research. However, as far as we know, the distinction between basic and advanced adopters has not previously been made.

We focus on e-commerce adoption and investigate e-commerce as a multi-level innovation by comparing two groups of companies, i.e. companies that only have some basic e-commerce technologies and companies that have implemented more advanced e-commerce applications. We posit that hands-on experience with the innovation influences the behaviour of the firm within the various stages of the Rogers (1995) innovation adoption model. We explore this hypothesis in an empirical study by using data from 127 Dutch SMEs (small and medium enterprises). In the analyses we control for both the intention to (further) adopt e-commerce and for various contextual factors. We explore also the possible interaction between adoption level and adoption intention. The results show significant differences between basic adopters and advanced adopters with respect to their knowledge, perceived potential value, implementation and satisfaction with e-commerce. We also find significant interaction effects that are consistently negative and tend to cancel out the additional effect of adoption intention for the companies at the advanced level of e-commerce.

The remainder of this paper is as follows. Firstly, we discuss the theoretical background of the study, focusing on the innovation adoption process and e-commerce as a multi-level innovation. The next section presents the hypotheses. After a brief discussion of the research design (the sample and measurements), we present the results of the data analyses. The paper ends with a discussion of the results and the main conclusions.

2 Theoretical background

In this section we present an overview of the relevant literature. We start with a brief discussion of the e-commerce adoption literature, leading to the conclusion that there is ample evidence to consider e-commerce as an innovation that can be adopted at multiple levels. The second part of this section focuses on the Rogers innovation adoption model and its use in innovation studies.

2.1 E-commerce as a multi-level innovation

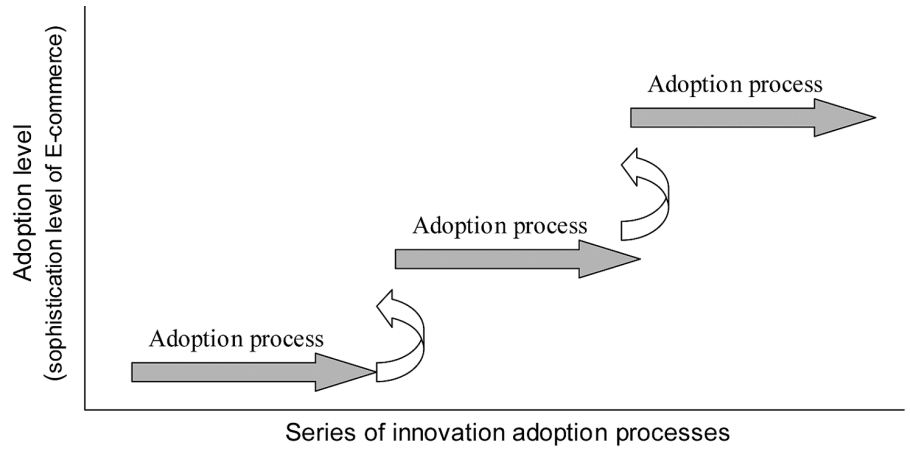
Although the adoption of many IT-based innovations can be studied as binary processes (e.g. the adoption of a computer, a software package or an ATM), there is ample evidence that e-commerce is an innovation that can be adopted stepwise. Bégin et al. (2001), studying Canadian web sites distinguished between three levels of sites, namely informational, promotional and transactional sites. Daniel et al. (2002) found four clusters of small firms that differed with respect to their level of e-commerce adoption, ranging from developers to companies offering online ordering. Sadowski et al. (2002) made a distinction between surfing, buying, providing information and selling. Other authors provide similar classifications, see for example Dholakia and Kshetri (2004), Levy and Powell (2003), Raymond (2001), Teo and Pian (2004). Since we are interested in innovations that can be adopted at multiple-levels, e-commerce seems to be an outstanding application to focus on.

2.2 The innovation process

The seminal work of Rogers (1962, 1995) is widely recognised as a useful starting point for studying innovation adoption behaviour. Rogers describes the adoption of a new product (or process) as a decision process that moves through different stages over time. The decision process begins with becoming aware of the existence and learning about the innovation (knowledge). In the next stage, the potential adopters attempt to assess the utility of the innovation (persuasion), then the decision is made whether or not to adopt the innovation. If the decision is in favour of adoption, the innovation is implemented. Finally, the experiences with the innovation are evaluated leading to either continuation or discontinuance (confirmation stage).

Considering our earlier conclusion that e-commerce can be considered as a multi-level innovation and building on Rogers' (1995) adoption model, we regard the decision to adopt e-commerce at one level as just one step in a series of similar adoption decisions. As visualised in Figure 1, the organisation moves through the adoption process multiple times, each time to reach the next adoption level. E-commerce may first be used to present the company and its offerings (a 'brochureware' site), then the company may add some interactive features by which potential customers get access to information and services tailored to their needs, next the company may include a transaction function for online ordering and, finally, the site may be fully integrated with internal systems, e.g. to enable customers to monitor the order fulfilment process. The positive and negative effects of e-commerce adoption experienced at one level may influence the willingness and the speed to move to the next level. In other words, as soon as a firm has implemented the lowest level of e-commerce, further expansions of e-commerce activities can be viewed as adopting the next level of an innovation.

Figure 1 E-commerce adoption considered as a series of innovation adoption decisions



Most studies based on the Rogers model concentrate on attributes related to the first two stages of the Rogers model (i.e. knowledge and persuasion) and how they influence the third stage (i.e. decision). In this study, however, we explicitly include the post-decision stages of the Rogers model (i.e. implementation and confirmation) since we consider

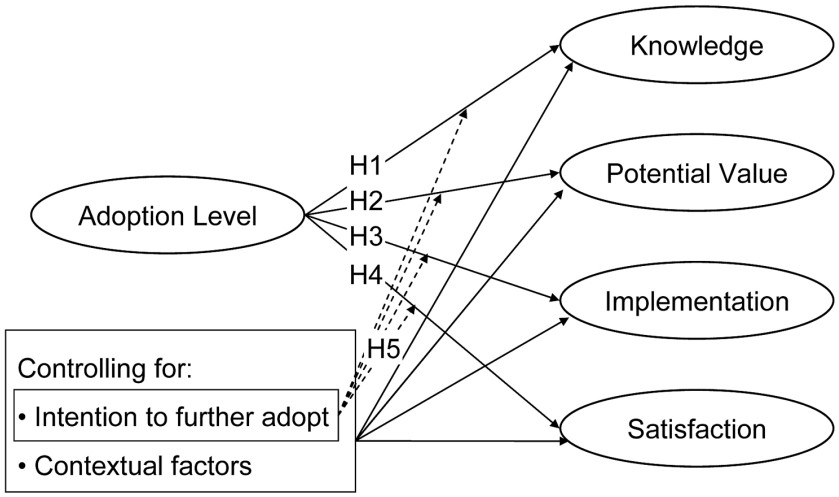
e-commerce adoption as a stepwise process, involving a series of incremental adoptions (Figure 1). The post-decision experiences of previous innovations influence subsequent adoption decisions and should therefore be included in the research model.

In the remainder of this paper we will use the terms 'potential value' and 'satisfaction' instead of Rogers' terms 'persuasion' and 'confirmation' (Rogers 1995, p.180). Potential value includes the perceptions of both the potential benefits and costs of adopting the innovation (Zhu and Kraemer, 2005). Satisfaction refers to a broader and more accurate concept, encompassing more than just the confirmation of the ideas the manager had before adopting the innovation. The level of satisfaction can be understood as the extent to which expected and unexpected advantages and disadvantages have been realised, reflecting the extent to which the respondent is content about having adopted the innovation.

3 Hypotheses

In this section we formulate hypotheses with respect to the impact the adoption level has on the four determining variables of the innovation adoption process, i.e. knowledge, potential value, implementation and satisfaction (see the conceptual model in Figure 2).

Figure 2 Conceptual model of the impact of the adoption level on the four determining variables of the innovation adoption process – the dotted lines indicate the possible interaction effects



3.1 Knowledge

Two types of knowledge are usually distinguished, tacit knowledge and explicit knowledge. While explicit knowledge can be gathered by means of desk research or conventional market research methods, tacit knowledge is acquired 'from the experiences one has while immersed in an environment' (Lubit, 2001). Acquiring tacit knowledge requires

having considerable experience in an activity. Similarly, hands-on experience with an innovation may increase the level of explicit knowledge. Activities such as developing a web site, studying competitors' e-commerce activities, discussing e-commerce with customers and e-commerce training of employees may increase the level of explicit knowledge in an organisation. This implies that if a company has had no or only very limited experience with e-commerce, we expect it to have less knowledge about this innovation compared with companies that are already applying e-commerce at a more advanced level.

Hypothesis 1

Companies at the more advanced e-commerce level have more knowledge with regard to e-commerce compared with companies at the basic level.

3.2 Potential value

Potential value represents the respondent's perception of the expected advantages of adopting e-commerce. These advantages consist of both the perceived benefits and costs that are evaluated within their internal and external context (i.e. their 'strategic fit'). We expect that companies with e-commerce experience have a more outspoken opinion about the expected impact of e-commerce. They have more e-commerce knowledge (see hypothesis 1) and have experienced the real world test of the textbook advantages of e-commerce. One may argue that this deeper understanding of the actual impact of e-commerce does not necessarily mean that these firms perceive more advantages of e-commerce. As the burst of the dotcom bubble has shown, just applying e-commerce does not guarantee profits. If companies at the advanced level developed their web sites in a rush and not as the result of a deliberate strategy (e.g. Angehrn, 1997; McBride, 1997), they may have found that e-commerce did not live up to their unrealistic expectations.

However, e-commerce has been around for almost a decade and we expect that most companies that are currently at the advanced level have invested in e-commerce more deliberately. Companies that have been found to have overinvested in the past, have had plenty of time to scale down their e-commerce operations. Also, because the initial threshold to implement e-commerce is quite low, we expect that companies still at the basic level must hold quite a strong believe that e-commerce does not add much to their business. Therefore, overall we assume a positive effect of adoption level on potential value.

Hypothesis 2

Companies at the more advanced e-commerce level have a more positive perception of the potential value of e-commerce compared with companies at the basic level.

3.3 Implementation

Implementation refers to the extent to which a firm is fully using the possibilities of the available e-commerce hardware and software (Tornatzky and Fleisher, 1990). Companies at the advanced level need to have more tools than companies at the basic level. Presumably, many firms at both the basic and the advanced level are not using all available e-commerce tools. However, since the companies at the advanced level by definition are using (part of) their basic tools, we expect them, on average, to use the available e-commerce hardware and software to a larger extent compared with companies at the basic level.

Hypothesis 3

Companies at the more advanced e-commerce level are using the available e-commerce hardware and software to a higher extent compared with companies at the basic level.

3.4 Satisfaction

Satisfaction refers to the extent to which respondents have a positive attitude towards what they have achieved by implementing e-commerce. Satisfaction is often explained as what you have achieved compared to some yardstick, where the yardstick can be anything from expectations, competitors, best practice companies, to investments.

Companies at the advanced level have invested considerable amounts of money, effort and time to reach that level and it is fair to assume that those companies have realised more of the potential value of e-commerce than companies at the basic level, resulting in higher satisfaction. Nevertheless, some of the companies at the advanced level may just have jumped on the e-commerce bandwagon without linking their internet efforts to their strategy. This group may be less satisfied with what they have achieved.

The group of companies at the basic level may also contain both companies that are satisfied with their low level of e-commerce and companies that have become dissatisfied. This dissatisfaction may result from the realisation that competitors have made major gains by innovative e-commerce applications or that an effective internet strategy requires more than just a simple web site. So, both groups may contain satisfied and less satisfied companies but given the general advantages of e-commerce we expect that, on average, the companies at the more advanced level will be more satisfied.

Hypothesis 4

Companies at the more advanced e-commerce level are more satisfied with their current e-commerce applications compared with companies at the basic level.

3.5 Adoption intention

In our conceptual model we control for the effect of various factors that could be related to the four determining variables of innovation adoption. First of all, we control for the intention to further adopt e-commerce (i.e. to extend the magnitude and/or domain of e-commerce (Lee and Grewal, 2004). This may seem odd, since adoption intention is usually considered a consequence and not an antecedent of the Rogers' stages variables. However, we want to rule out the possibility that our hypotheses will be confirmed just because the companies at the advanced level have a higher adoption intention. By including adoption intention as a control factor and *not* as an antecedent, we are able to disentangle the effects of both factors.

3.6 Interaction

Both factors, adoption level and adoption intention, may be related to the four dependent variables (knowledge, potential value, implementation and satisfaction) but their effects may also be related. In other words, it is possible that there exists an interaction effect between both factors. This implies that the relation between adoption level and, for example, knowledge would be different for firms without the intention to expand their e-commerce activities compared with firms that do have such an intention. The interaction effect is positive when the combined effect of both factors is larger than their separate (main) effects. This situation reflects synergy, in more popular terms: $1+1=3$. The

interaction effect is negative when the combined effect of both factors is smaller than their main effects (1+1<2). Companies at the advanced level may perceive more advantages of e-commerce compared with companies at the basic level (positive main effect) but the additional effect of having the intention to further adopt e-commerce is smaller for companies at the advanced level (negative interaction effect). A possible explanation for negative interaction is that, at the basic level, the unrealised potential of e-commerce is larger. Porter (2001) suggested that e-commerce, just like many other economic phenomena, has diminishing returns.

Finally, it is also possible that there is no interaction (1+1=2). In that case, the level of adoption has an effect irrespective of whether or not a company intends to further adopt e-commerce. To our best knowledge this interaction effect has not been studied before. Therefore we do not formulate a set of directional hypotheses but will study the possible interactions in an exploratory manner.

Hypothesis 5-abcd

The effect of the current level of e-commerce (basic or advanced) on (a) knowledge, (b) potential value, (c) implementation and (d) satisfaction is different for companies that do not intend to further adopt e-commerce compared with companies that intend to further adopt e-commerce.

3.7 Contextual factors

Finally, in our conceptual model we also control for the effect of several contextual factors that may be related to the Rogers stages. The literature review revealed three factors that are often used in SME innovation studies, i.e. the industry (e.g. LaRose and Hoag, 1996), firm size (e.g. Dholakia and Kshetri, 2004; Luchetti and Sterlacchine, 2004; Thong 1999) and market share position (De Jong et al., 1994).

4 Research design

4.1 Sample

Data were collected using a postal survey among small and medium sized firms that currently use e-commerce. Their uses range from having a simple website to actually selling and servicing via the internet. In developing and executing the survey, we collaborated with Syntens, a Dutch chain of government subsidised regional innovation promoters targeting SMEs (cf. Nooteboom et al., 1994). The sample consisted of 1600 SMEs, 600 firms from Syntens' customer database and 1000 firms from the major commercial database of MarktSelect. A total of 137 questionnaires were returned, two of which were excluded for further analyses because these firms had no employees. Eight companies were excluded because they did not meet the requirement of having basic e-commerce technologies, i.e. e-mail, electronic data interchange (EDI), internet access, company website, extranet or mobile data communication. This left us with 127 usable responses (net response rate of 7.9%).

The large majority of respondents are CEOs (79%) owning the firm (82% of the responding CEOs). The average firm size is 19 employees (36% between one and nine employees, 32% between ten and 19, and 28% between 20 and 99). Average turnover is 3.9 million euros.

4.2 Measurement

Where possible measurements from literature were used, both multi-item constructs and single item measurements. Since we had to adapt some existing scales and develop new ones, experts of Syntens were involved in the scale development process. Below, we briefly discuss the scales, see the appendix for an overview of all items used.

To measure the *level of adoption* respondents were asked to indicate whether they used e-commerce for purchasing, sales and/or customer service purposes. Due to our sample size, we limit the number of levels of e-commerce adoption to two. If the company is not using e-commerce for at least one of the three processes, it is classified at the basic e-commerce level (48% of the responses), otherwise at the advanced level (52%).

In order to measure *knowledge* we used a literature review and expert interviews to identify 11 types of information relevant in e-commerce adoption decisions (of SMEs). For each item respondents indicated on a five-point Likert scale the availability of this information. The variable knowledge reflects the average of these scores. Also, based on the literature review and expert interviews, we developed a list of 18 items reflecting beliefs about the *potential value* of e-commerce. Sample items include improved sales, cost savings and customer need. Potential value is the mean score on these 18 beliefs (on a five-point Likert scale). *Implementation* is measured as the extent to which a company is currently using the available e-commerce applications (Tornatzky and Fleisher, 1990). This is a single item measure on a 1–10 scale (from no use to complete use). *Satisfaction* reflects the respondent's overall attitude based on previous experiences (Garbarino and Johnson, 1999). To measure this variable we used a three step procedure, based on Ajzen and Fishbein (1980), in which importance ratings are applied to select a limited number of salient beliefs. Satisfaction is measured as the weighted mean score of the respondent's satisfaction regarding the most important potential value beliefs.

The four control variables were measured as follows. For the *intention to further adopt* e-commerce we asked respondents whether they were planning to expand their e-commerce activities in one of three processes (purchasing, sales and customer service) within two years. Only 'considerable' expansions were included. The variable intention reflects the number of processes for which a firm is planning to expand its e-commerce activities. *Organisation size* is measured by the number of employees (full time equivalents). Following Shalit and Sankar (1975) we take the natural logarithm of this variable to reduce the skewness of its distribution. The major determinant of e-commerce use in a specific *industry* is its information intensity (Thong, 1999). Therefore, we divided the companies into a high information intensive group (i.e. wholesale trade, transportation, professional services and other services) and a low information intensive group (i.e. manufacturing, contracting and other production activities). Finally, *market share position* is measured on a four-point scale, ranging from one of the smaller players to the market leader (De Jong et al., 1994).

5 Results

Table 1 contains the descriptive statistics for the four dependent variables (knowledge, potential value, implementation and satisfaction) for both the entire sample and for the two groups of interest: companies at the basic level (n=56) or advanced level (n=61) of e-commerce. The mean scores of both groups provide initial support for our hypotheses:

in all four cases the companies at the advanced level exhibit higher mean scores for the dependent variables compared with companies at the basic e-commerce level. The results of the t-test reflect these differences: in all four cases the t-values show highly significant differences.

Table 1 Descriptive statistics: the mean scores, standard deviations (in parentheses) and t-test results for the four dependent variables

Dependent variables	*Overall statistics*			*Adoption level*		*Results t-test*	
	Mean	*Min*	*Max*	*Basic level*	*Advanced level*	*t-value*	*p-value (2-tailed)*
Knowledge	2.8	1.0	3.9	2.4 (0.77)	3.1 (0.77)	4.63	0.000
Potential value	3.0	1.0	5.0	2.7 (0.88)	3.3 (0.74)	3.39	0.001
Implementation	6.1	1.0	10.0	4.8 (2.06)	7.4 (1.95)	7.08	0.000
Satisfaction	14.9	4.0	25.0	13.6 (3.66)	15.9 (3.36)	3.27	0.001

To test our hypotheses we performed regression analyses for each of the four dependent variables. The independent variables are the adoption level (basic or advanced), the intention to further adopt e-commerce, the interaction between these two factors and the three contextual factors (organisation size, industry and market share position). The results are displayed in Table 2.

Table 2 Results of the regression analyses for the four dependent variables[a]

Independent variables:	*Dependent variable*			
	Knowledge	*Potential value*	*Implementation*	*Satisfaction*
Adoption level	0.63 (0.000)***	0.49 (0.000)***	0.66 (0.000)***	0.56 (0.000)***
Intention to adopt	0.37 (0.001)***	0.47 (0.000)***	0.11 (0.297)	0.24 (0.080)*
Adoption level *Intention	−0.39 (0.004)***	−0.29 (0.047)**	−0.25 (0.063)*	−0.46 (0.005)***
Organisation size	−0.09 (0.356)	−0.03 (0.734)	0.00 (0.980)	−0.09 (0.380)
Industry	0.17 (0.052)*	0.08 (0.396)	0.15 (0.073)*	0.14 (0.160)
Market share position	0.20 (0.031)**	0.12 (0.214)	0.08 (0.405)	0.17 (0.100)*
Adjusted R2	0.32	0.20	0.31	0.18
N	108	111	112	97

Notes: *p<0.10, **p<0.05, ***p<0.01 two-tailed.

[a]Standardised β-coefficients, figures in parentheses are two-tailed p-values.

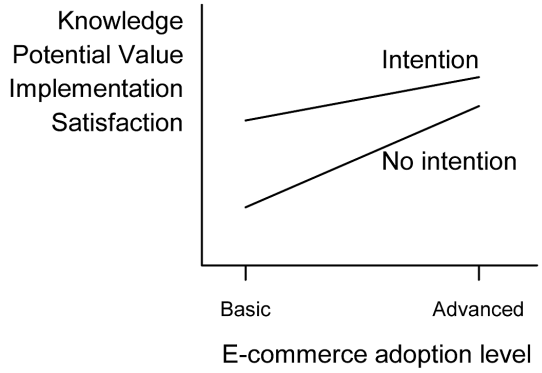
The main conclusion of these findings is that adoption level is an important predictor of the level of knowledge, potential value, implementation and satisfaction. In all four cases adoption level has a positive and highly significant relationship with the dependent variable, even when controlling for the impact of the intention to further adopt e-commerce. Also,

in all four cases the magnitude of this effect is rather large. These results confirm the four main hypotheses, suggesting that companies at the advanced level of e-commerce differ significantly from companies at the basic level. Companies at the advanced level have more knowledge about e-commerce, perceive a higher potential value of e-commerce, are using the available e-commerce tools to a larger extent (implementation) and are, in general, more satisfied about their current e-commerce activities.

The additional hypotheses (5-abcd) refer to the possible interaction between adoption level and the intention to further adopt e-commerce. In the analyses we controlled for the direct effect of the intention to further adopt and in three of the four cases this direct effect is positive and significant. The hypotheses with respect to the interaction effect of adoption level and intention to further adopt were formulated in an explorative way, without assuming a direction. The interaction effect turned out to be significant in all four cases. The magnitude of these effects is smaller than those of the direct effects of adoption level but comparable with those of intention.

In all four cases, the direction of the interaction effect is negative. This implies that, although the adoption level and the intention to further adopt both have a positive effect, their combined effect is less than the sum of the two direct effects. In combination their effects are dampened, which is illustrated graphically in Figure 3 or even cancelled out. Please note that the negative interaction effects are not caused by a statistical ceiling effect: this would imply that companies at the advanced level exhibit scores at the far upper end of a scale (say: a mean of 4.8 on a 1–5 scale), which seriously limits the additional effect that any other factor can have. The means in Table 1 show that for all four dependent variables there is considerable space for higher scores.

Figure 3 A simplified illustration of the negative interaction effect of adoption level and intention to further adopt, while the direct effect of both factors is positive



These findings mean that, on average, companies at the basic level score lower than companies at the advanced level of e-commerce. Also, companies that intend to further adopt e-commerce score higher than the companies that do not intend to further adopt e-commerce. However, the combined effect of both factors is flattened out or even cancelled out (as in the knowledge and satisfaction models, where the magnitudes of adoption intention and the negative interaction effect are similar).

6 Discussion and conclusion

Most innovation researchers tend to consider innovation adoption as a binary process, implying that companies have either adopted an innovation or not. However, to balance risks and expected benefits, managers prefer to adopt innovations stepwise. In this paper we have considered e-commerce as an innovation that can be adopted at multiple levels. Using the main variables from the well-known Rogers (1995) innovation adoption model, we investigated the differences between companies at the basic and advanced level of e-commerce with respect to their knowledge, potential value, implementation and satisfaction with e-commerce.

For each of these four stages we hypothesised higher scores for companies at the advanced level. Our empirical study confirmed these hypotheses. In all four models, the effect of the adoption level is significant, positive and of a relatively large magnitude. Even when controlling for the effects of the intention to further adopt e-commerce and several contextual variables, this conclusion still holds. These results imply that for researchers investigating e-commerce adoption by using (variables from) the Rogers model or similar factors, it may make sense to explicitly incorporate the current level of e-commerce adoption into their models. This will offer opportunities for a greater understanding of the process that leads to further e-commerce adoption and how to influence this process. For e-commerce consultants and managers, these findings provide evidence that they should not neglect the effect of getting experience with an innovation. Getting hands-on experience with e-commerce influences the level of knowledge, potential value, implementation and satisfaction which, in turn, may affect the willingness of individual employees to integrate e-commerce into their daily activities and/or the willingness of the company to further invest in e-commerce.

In this study we also explored the interaction between the adoption level and the intention to further adopt e-commerce. Since previous research and theories were largely absent, we approached this topic in an explorative manner. We found that, in all four models, the interaction effect was significant and negative. This implies that adoption level and adoption intention do not strengthen but tend to weaken each other. In terms of magnitude of effects we found that the effects of adoption intention and the interaction term were quite similar. The net result is that, at the highest adoption level, the positive effect of adoption intention and the negative interaction effect tend to cancel each other out. We will illustrate these findings for the knowledge variable. We find that companies at the advanced level of e-commerce, on average, know more about e-commerce than companies at the basic level. Also, companies with intention to further adopt e-commerce know more than companies that do not intend to further expand their e-commerce activities. However, for companies at the advanced level we find no difference in knowledge when comparing the groups with and without intention. The additional positive effect of intention is completely cancelled out by the negative interaction effect. These are very interesting findings, both the consistently negative interaction effect and the relatively large magnitude of this effect. Since the theoretical foundations of these findings are still rather weak, we recommend this as an area for further (theoretical) research.

Although this study focused on e-commerce adoption, we argue that there are many more innovations that can be adopted at multiple levels. Researchers dealing with such innovations may benefit from explicitly considering the current level of innovation

adoption. Unless the number of companies at the various adoption levels is perfectly split in the sample, we conclude that omitting the level of adoption may lead to biased results and non-sustainable recommendations.

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Appendix – Measurement scales

Adoption level	
Currently using e-commerce for selling, purchasing or customer service	Dichotomous yes/no
Knowledge (availability of information on specific topics):	
Customer need	5-point Likert scale
Supplier need	
Opportunities	
Financial benefits	
Costs	
Technical specifications	
Experiences of peers	
Necessary skills	
Needed resources	
Organisational impact	
Competitors' activities	
Potential Value (beliefs on relevance of specific factors for firm's major e-commerce investment)	
Effect on firm's image	5-point Likert scale
Customer need	
Supplier need	
Time savings	
Cost savings	
Improved sales	
Improved profitability	
Improved (brand) awareness	
Improved transfer of product information	
Being industry innovator	
Need to keep up in industry	
Improved product development	
New customer contacts	
International selling	
Learning about new medium	
Improved customer service	
Improved customer relations	
Decreasing stocks	

Implementation	
Usage level of all available e-commerce applications within the firms	10-point scale ranging from nil to fully
Satisfaction	
Satisfaction with results of e-commerce pertaining to the 18 items of potential value	5-point Likert scale
Control variables	
Firm size (full time equivalents)	Numerical
Industry (information intensity)	Dichotomous low/high
Market share position	4-point scale
Intention to expand e-commerce use for selling, purchasing and/or customer service within the next two years	Scale 0–3

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