A multi-country study of the adoption of ERP systems: The effect of national culture

Yvonne M. van Everdingen, Eric Waarts

ERIM REPORT SERIES *RESEARCH IN MANAGEMENT*	
ERIM Report Series reference number	ERS-2003-019-MKT
Publication	March 2003
Number of pages	33
Email address corresponding author	yeverdingen@fbk.eur.nl
Address	Erasmus Research Institute of Management (ERIM) Rotterdam School of Management / Faculteit Bedrijfskunde Rotterdam School of Economics / Faculteit Economische Wetenschappen Erasmus Universiteit Rotterdam P.O. Box 1738 3000 DR Rotterdam, The Netherlands Phone: +31 10 408 1182 Fax: +31 10 408 9640 Email: info@erim.eur.nl Internet: www.erim.eur.nl

Bibliographic data and classifications of all the ERIM reports are also available on the ERIM website: www.erim.eur.nl

ERASMUS RESEARCH INSTITUTE OF MANAGEMENT

REPORT SERIES

RESEARCH IN MANAGEMENT

BIBLIOGRAPHIC DATA AND CLASSIFICATIONS		
Abstract	Studies on the adoption of innovations by companies generally include micro-level and meso-level variables in order to explain a company's receptiveness to innovations. This study adds to the literature by investigating the role of macro-level variables (i.e. national culture) to explain differences in innovation penetration levels and adoption decisions by companies across national cultures. A large-scale empirical study was carried out in 10 European countries concerning the adoption of Enterprise Resource Planning (ERP) software by mid size companies. Results indicate variables describing national cultural to have a strong, significant influence on the innovation penetration and adoption. In addition, we find adoption models including micro-, meso- and macro-level variables to perform significantly better in explaining innovation adoption across countries than adoption models that only include micro- and meso-level variables.	
Library of Congress Classification (LCC)	5001-6182	Business
	5410-5417.5	Marketing
	HD 45+ HD 58.7	Technological innovations Organizational behavior
Journal of Economic Literature (JEL)	M	Business Administration and Business Economics
	M 31 C 44	Marketing Statistical Decision Theory
	O 31	Innovation and invention
European Business Schools Library Group (EBSLG)	85 A	Business General
	280 G 255 A	Managing the marketing function Decision theory (general)
	15 A 65 A	Technological innovations Intercultural management
Gemeenschappelijke Onderwerpsontsluiting (GOO)		
Classification GOO	85.00	Bedrijfskunde, Organisatiekunde: algemeen
	85.40	Marketing
	85.15 850.08	Onderzoek en ontwikkeling Organisatiesociologie, organisatiepsychologie
Keywords GOO	Bedrijfskunde / Bedrijfseconomie	
	Marketing / Besliskunde	
	Innovatie, Cross-culturele vergelijkingen, ERP	
Free keywords	Innovation; Cross-cultural; Organizational behavior; ERP	

A multi-country study of the adoption of ERP systems: The effect of national culture

Yvonne M. van Everdingen[1]

Eric Waarts

Rotterdam School of Management

Erasmus University Rotterdam

The Netherlands

[1] Contact address: Erasmus University Rotterdam, Faculty of Business Administration, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands. E-mail: yeverdingen@fbk.eur.nl

A multi-country study of the adoption of ERP systems: The effect of national culture

Abstract

Studies on the adoption of innovations by companies generally include micro-level and meso-level variables in order to explain a company's receptiveness to innovations. This study adds to the literature by investigating the role of macro-level variables (i.e. national culture) to explain differences in innovation penetration levels and adoption decisions by companies across national cultures. A large-scale empirical study was carried out in 10 European countries concerning the adoption of Enterprise Resource Planning (ERP) software by mid size companies. Results indicate variables describing national cultural to have a strong, significant influence on the innovation penetration and adoption. In addition, we find adoption models including micro-, meso- and macro-level variables to perform significantly better in explaining innovation adoption across countries than adoption models that only include micro- and meso-level variables.

Key search words

Innovation; Cross-cultural; Organizational behavior; ERP

Introduction

While new products, systems or services are frequently launched in multiple countries, it is not uncommon for products to have high rates of adoption in particular countries but low rates in others. Even within Europe. For example, a few years ago the Internet was used by 35% of the Austrian and Britain small and medium-sized enterprises (SME's) but only by 12% of the Swedish SME's (EOS Gallup Europe, Telecommunications Survey 1999). Consequently, for suppliers of business-to-business innovations it becomes increasingly important to know to what extent companies in a particular country are more receptive to certain types of innovations than companies in other countries.

More than fifteen years ago, Robertson and Gatignon (1986) proposed a groundbreaking model of organizational adoption, including meso-level variables (characteristics of the industry) and micro-level variables (organization and innovation characteristics), which has thereafter been adapted and tested by many researchers (a.o. Gauvin and Sinha, 1993; Frambach, Barkema, Nooteboom and Wedel, 1998; Montaguti, Kuester and Robertson, 2002). Though meso- and micro-level variables can account for differences in diffusion patterns within countries or industries, it cannot explain differences in diffusion patterns across countries due to variances in the national cultural environment. Recently, researchers started to pay more attention to the role of national culture (i.e. a macro-level variable) to explain a

company's adoption behavior and innovation diffusion in a business-to-business context. Newell, Swan and Robertson (1998) found significant differences in adoption rates of Business Process Engineering (BPR) across four European countries (UK, France, The Netherlands and Sweden), ranging from 23% for the UK to 41% for The Netherlands. They advocate including variables at the macro-national level, in addition to the traditional meso- and micro-level variables, to explain differences in penetration and adoption. A recent study by Png, Tan and Wee (2001) on the adoption of frame relay, a type of IT infrastructure, was the first actually doing that. Png et al. did not only signal differences in adoption rates across countries but also explored the impact of two Hofstede dimensions of national culture (the uncertainty avoidance index and the power distance index) on the adoption behavior. Only for the uncertainty avoidance index a significant, negative, effect was found. As far as we know the Png et al. study is currently the only one investigating the influence of national cultural variables on the adoption decision of companies. Still, the study was limited to two countries (US and Japan), and included only two of the five Hofstede dimensions.

The objective of our study is to investigate more extensively the influence of macro-level variables on the adoption and diffusion of innovations, relative to the traditional meso- and micro-level variables. We extend the Robertson and Gatignon model (1986) by including macro-level variables, i.e. country specific cultural variables as explanatory factors of organizational adoption and diffusion. We discuss two dominant culture theories, i.e. the national culture classifications of Hofstede (2001) and Hall (1976), and demonstrate to what extent these classifications help explaining cross-national organizational adoption behavior and diffusion patterns, in addition to the meso- and micro-level variables.

For that purpose we use data on the adoption of a complex IT-based innovation, i.e. Enterprise Resource Planning (ERP) software, by more than 2600 medium-sized companies across 10 European countries. ERP software emerged over the past decade, and is considered to be a new generation of packaged application software, in succession to packages such as material requirements planning (MRP) and manufacturing resource planning (MRPII) (Klaus, Rosemann and Gable, 2000). It does not only calculate the materials needed as MRP does, but it seeks to integrate the complete range of business processes and functions by means of a single information and IT architecture. While many large organizations have already adopted ERP, at the time of the survey most small- and medium-sized companies still had to make the decision whether or not they wanted to deploy ERP (Kara, 1999). Adopting ERP can be considered a major business decision affecting many aspects of a firm's business functions.

To give an impression of the variation in our sample across the European countries, Figure 1 shows the ERP adoption rates in the various countries on two periods in time, 1998 and 2000 respectively (for a discussion of the sample procedures see the section on the research method). As can be seen the rates of adoption differ substantially between countries. The Nordic countries (Denmark, Sweden, Norway) have relatively high adoption rates while the UK and southern countries like Spain score significantly lower. The adoption rates point to the usual research question in adoption studies why some companies within a country adopt an innovation and others don't. But it also triggers to investigate why in some countries a higher proportion of companies adopt an innovation than in other countries. In line with this, we formulated two specific research questions that will be dealt with in the remainder of this article:

(1) Can cross-national differences in diffusion patterns be explained by national culture?
(2) To what extent does the national culture as a macro variable add to meso- and micro-level variables for explaining companies innovation adoption behavior?

- Figure 1 about here -

In the sections to follow, we present our research framework, and formulate specific macro-factor-related hypotheses for explaining the cross-country adoption and diffusion of innovations, specifically ERP software. Then we explain the methods used for the empirical study, followed by the analyses and the results. Theoretical and practical implications are discussed in the final part of the article.

Research conceptualization

Figure 2 depicts our research model. Related to the research questions we focus on two dependent variables, (1) the country penetration rates, i.e. the ERP penetration rates for the 10 European countries, and (2) the likelihood of adoption of an innovation by a company, in this study the adoption of an ERP system by medium-sized companies. The aggregation of adoptions by individual companies within a country lead to the country penetration rates.
The macro-level variables are expected to influence these cross-country penetration rates (research question 1). To explain the adoption decisions of individual companies we include not only variables at the macro-level (country specific characteristics), but also variables at the "traditional" meso-level (industry characteristics) and micro-level (company and innovation characteristics). This provides us with the opportunity to focus on the relative influence of each of the three levels of variables, and to find out to what extent the national cultural variables add in explaining the adoption behavior of individual companies (research question 2).
Below we will focus our discussion and hypotheses on the macro level factors since these are of primary concern in this study, and they are new in the context of explaining adoption and diffusion of innovations in a business setting. Thereafter, we will also briefly address the meso- and micro factors involved in this study.

- Figure 2 about here -

Macro-level variables

International marketers have a number of models at their disposal describing national culture. Two well-known classifications of culture are the Hofstede's cultural framework (2001) and the cultural classification by Hall (1976). Both theories will be discussed in detail below, and hypotheses will be formulated linking these cultural classifications to adoption and diffusion of innovations.

Hofstede culture dimensions

According to Sivakumar and Nakata (2001), the cultural framework of Hofstede has garnered the greatest attention from business scholars in recent years, and is well established in international marketing. The original Hofstede framework consisted of four dimensions to describe culture, i.e. power distance index (PDI), uncertainty avoidance index (UAI), individualism index (IDV), and masculinity index (MAS). These dimensions were derived through a survey, containing many questions about values, conducted within subsidiaries of a large multinational (IBM) in 72 countries. The data were collected twice, in 1968 and 1972, and resulted in more than 116.000 usable questionnaires. Recently, a fifth dimension, long-term orientation (LTO), has been added to this framework (Hofstede, 2001). The value connotations and attitudes found, at the national level, of the cultures with high and low scores on these dimensions are summarized in Table 1.

- Table 1 about here -

So far, the culture dimensions of Hofstede have been applied in innovation studies explaining national innovativeness (see Shane, 1993; Lynn and Gelb, 1996) and cross-national consumer innovativeness (see Steenkamp, ter Hofstede and Wedel, 1999; Yaveroglu and Donthu, 2002). With the exception of a study by Png, Tan and Wee (2001), who included only two out of the five dimensions, the Hofstede framework has not yet been applied in explaining adoption and diffusion of innovations in a business-to-business context. This is quite remarkable, since originally the Hofstede's dimensions are based on a multi-country study in a business setting (IBM). In order to gain insights in the role of all Hofstede culture dimensions in explaining innovation adoption and diffusion within the business environment, we apply this framework to ERP adoption.

Power Distance Index (PDI)
According to Hofstede organizations in countries with high power distance are often characterized by centralized decision structures, authority, the use of formal rules, and the sharing of information is constrained by hierarchy. High levels of centralization and formalization have been found to be associated with lower rates of innovation adoption (Zmud, 1982). A reason might be that in centralized organizations, top management is not always able to identify operational problems and to suggest the introduction of innovations to solve these problems. Moreover, in formal organizations, subordinates may take less initiative to consider and discuss the introduction of new products within the company. They will generally wait for the top management to take the initiative. Hence we suggest the following hypothesis:

Hypothesis 1:
The higher the country's PDI score the less likely companies in that country adopt innovations (ERP), and the lower the innovation (ERP) penetration rate in that country.

Uncertainty Avoidance Index (UAI)
Organizations in countries with a high uncertainty avoidance index generally show characteristics, such as the resistance of innovations, highly formalized management and the constraining of innovations by rules (Hofstede, 2001). In high UAI cultures, risk-averse attitudes imply that companies will not take unnecessary risks and only adopts innovations if its value has already been proven in the market. Png et al. (2001) included this index in order to explain cross-country adoption by companies and indeed found a significant negative effect. Hence we hypothesize the following:

Hypothesis 2:
The higher the country's UAI score, the less likely companies in that country adopt innovations (ERP), and the lower the penetration rate.

Individualism Index (IDV)
This dimension describes the relation between the group and the individual. In collectivistic countries one act conform the norms of the group. Furthermore, organizations in collectivistic cultures are characterized by collective decisions, which may lead to a delay in the adoption decision process. In contrast, in individualistic countries people make their own choices. Also within organizations, there is a belief in individual decisions. Employees of organizations in individualistic countries do have more freedom to develop or try new products than employees of organization in collectivistic countries. Consequently, patents are more often granted in individualistic than in collectivistic countries (Hofstede, 2001). Furthermore, studies by Shane (1993) and Lynn and Gelb (1996) have also shown a positive relation between individualism and national innovativeness. Hence, we propose the following hypothesis:

Hypothesis 3:
The higher the country's IDV score, the more likely companies in that country adopt innovations (ERP), and the higher the penetration rate.

Masculinity Index (MAS)
This Index expresses to what extent a national culture is characterized by masculine respectively feminine values. Feminine cultures are characterized by values like equality, solidarity, social relationships and managers' use of intuition and seeking consensus. In contrast, ambition, competition, material values and the focus on performance characterize masculine cultures. Hofstede (2001) suggests that in organizations in masculine cultures emphasis is on rewards and recognition of performance, and moreover training and improvement of the individual, both characteristics that are common to innovative organizations. Rogers (1995) suggest a

positive relationship between achievement motivation and innovativeness. In line with this, we hypothesize:

> Hypothesis 4:
> The higher the country's MAS score, the more likely companies in that country adopt innovations (ERP), and the higher the penetration rate.

Long-term Orientation Index (LTO)

Long-term orientation is a newly defined dimension in the Hofstede scheme. Cultures with a long-term orientation are characterized by values like persistence, adaptations of traditions to new circumstances, personal adaptability, and the idea that most important events in life will occur in the future. In line with this, we expect that companies in cultures with a long-term orientation focus on future results, and are more receptive to changes than companies operating in a short-term orientation culture. Contrary, in cultures with short-term orientation the focus is on the past, and people respect tradition, and therefore these types of cultures is expected to be less innovative.

> Hypothesis 5:
> The higher the country's LTO score, the more likely companies in that country adopt innovations (ERP), and the higher the penetration rate.

Hall's cultural classification schemes

The second dominant culture theory we focus on is the theory of Hall who distinguishes between high and low-context cultures, and secondly between monochronic and polychronic cultures (1976). Both classifications are discussed below.

Low versus high context cultures

Table 2 shows a classification of countries in low and high context, their characteristics and the expected role in adoption decisions. This distinction is based on the way messages are communicated within a society. In high-context cultures (e.g. Italy, Japan, China) contextual cues are important in the interpretation of a message, while in low-context cultures (e.g. Germany, Switzerland, the US) most of the information is contained explicitly in words (Czinkota and Ronkainen, 1998). According to Morden (1999), people from high-context cultures try to become well-informed about facts by obtaining information from personal information networks. Alternatively, people in low-context cultures seek information about decisions from a research base and use information sources such as reports, databases, information highways, and the Internet. This seems to be the type of information sources where companies try to seek information for making innovation adoption decisions for a new information system.

- Table 2 about here -

The Hall-distinction between high and low-context has not yet been applied in business-to-business high tech innovation research yet. Given the fact that the adoption decisions in companies are based on thorough information processing using multiple sources and can be characterized as a rational decision-making process, it can be expected that companies operating in low-context cultures using formal information sources are faster in adopting imperative innovations like ERP systems. Personal network influences, which are important drivers in high context cultures, may become more relevant when already a considerable portion of companies have already adopted the innovation or are deciding on it.

> Hypothesis 6:
> In low context countries, companies are more likely to adopt an innovation (ERP), and the penetration rate is higher, than in high context countries.

Monochronic versus polychronic cultures
Another distinction Hall (1976) made is based on a culture's attitude towards time. Hall distinguishes between cultures with a monochronic and a polychronic notion of time. Table 3 classifies countries as either monochronic or polychronic and summarizes the characteristics of these two types of cultures.

- Table 3 about here -

People in monochronic cultures act in a focused manner, concentrate on one thing at a time, and tend to be well organized and punctual. People in polychronic cultures can be considered to be less organized, being less punctual and doing many things at once, in an opportunistic way (Morden, 1999). According to Kotabe and Helsen (2001), monochronic time cultures often are low-context cultures, while polychronic time cultures can be associated with high-context cultures. In addition, a decision to implement an ERP system fits properly with well-organized and punctual organization styles. Consequently, we expect the following:

> Hypothesis 7:
> In monochronic countries, companies are more likely to adopt innovations (ERP), and the penetration rate is higher, than in polychronic countries.

So far, we have focused on the macro-factor component of our research model related to differences in adoption and diffusion across countries, which should enable us to answer research question one. The second research question posed in the introduction involves the influence of national culture relative to the meso- and micro-level variables in explaining adoption decisions of individual companies. We suggest that it is necessary to add macro-level variables to the traditional adoption models, containing only meso- and micro-level variables, if adoption and diffusion patterns across countries have to be analyzed. Meso- and micro-level variables alone cannot fully explain differences in diffusion patterns across countries due to the variances in national culture. The national culture in which a company operates is expected to have

an influence on the innovative behavior of that company. Therefore, we propose the following hypothesis:

> Hypothesis 8:
> Adoption models including macro-, meso- and micro-level variables in order to explain the adoption behavior of individual companies outperform adoption models including only meso- and micro-level variables.

To be able to test hypothesis 8 we now will proceed with the selection of the relevant meso- and micro-factors. Since many studies have already addressed these factors and their influence on a company's adoption behavior, we will not formulate and test formal hypotheses here. The purpose of the selection of the relevant meso- and micro-variables is to test whether the macro-component factors improve the quality of the model compared to a model with meso and micro factors only.

Meso-level variables

Most studies include two types of these factors: industry competitiveness and supply side activities targeted on the industry. These factors have been found to influence the adoption decisions made by individual companies within the industries. In our study, we include both elements.

IT competitiveness in the sector
Competitors can be important drivers in adopting an innovation. It is known that competition generally increases the likelihood of innovation adoption (Gatignon and Robertson, 1989; Kimberly and Evanisko, 1981; Levin, Levin and Meisel, 1987; Link and Bozeman, 1991). According to Gatignon & Robertson (1989), intense rivalry between firms prompts them to pay close attention to each other's competitive moves, and therefore accept technological innovations relatively fast. It can therefore be expected that a firm is more likely to invest in an ERP system if its business is located in a market where IT is a major competitive driving force and where IT budgets are strongly accelerating. In highly competitive markets competitive bandwagon pressures occur "because as the proportion of adopters increases, potential adopters experience a growing risk that if the innovation is a success, their performance will fall well below the average performance of other potential adopters; they adopt to avoid running this risk (Abrahamson and Rosenkopf, 1997).

Supply-side activity
The marketing activities of suppliers also play an important role in getting the innovation accepted in the market place. After all, if suppliers do not put an effort into convincing medium-sized companies in particular industries to implement an ERP system, the odds are that few firms will actually adopt it. Frambach et al. (1998) have shown that the more active firms are, in terms of targeting and communicating the innovation, the more customers will be aware of their products and the more likely they are to consider buying it.

Micro-level variables

Also at the micro-level, the literature suggests two categories of variables that may influence the adoption and diffusion of an innovation by organizations, i.e. perceptions of the innovation characteristics and the adopter characteristics (Robertson and Gatignon, 1986; Newell et all, 1998; Van Everdingen and Bamossy, 2000; Frambach and Schillewaert, 2002).

Perceived innovation characteristics
Generally, a company's adoption decision will be made on the basis of comparing the expected situation after adoption to the current situation or available alternatives. The value of an innovation, in terms of the advantages compared to existing solutions, will be considered together with the costs of adoption, to make the adoption decision (Anderson, Thomson and Wynstra, 2000). It has been found that the relative advantage of an innovation, as perceived by members of a social system, is positively related to its rate of adoption (Rogers, 1995).
In the case of IT innovations, besides relative product advantages, also the compatibility with the current IT infrastructure is an important consideration when deciding on adopting. Buying and implementing ERP isn't a simple task; it may require huge changes in current work-related norms and procedures. Consequently, the product fit with current procedures, and the possibility of relatively fast implementation will be considered as important factors in making the ERP adoption decision.

Adopter characteristics
Frambach and Schillewaert (2002) suggest three categories of adopter characteristics influencing a company's adoption behavior, i.e. the size of a company, the structure, and the organizational innovativeness. We shall include these in our model. The size of an organization has been included many times in adoption studies, and has been found to positively influence the adoption decision (Frambach et al. 1998; Thong, 1999). Structure of an organization refers (in the case of ERP) to the level at which information processes and systems are integrated across various functional areas within the organization. This aspect is particularly relevant for ERP software, since this type of software claims to be especially appropriate for integrating business process information. The final micro-level variable, a company's innovativeness, refers to the attitude of a company towards the adoption of new products, or in other words the receptiveness of an organization towards new ideas (Baldwin and Scott, 1987). IT-savvy organizations, frequently pioneering and trying new information technologies, are likely to adopt or invest in ERP sooner / faster than IT conservative companies.

Research method

The data we use for this study was collected via a survey, and includes a large sample (N=2647) of mid size firms from ten European countries (Finland, Sweden, Norway, Denmark, the Netherlands, Belgium, France, Spain, Italy and the United Kingdom). We have large sample sizes across the countries varying from 221 companies from Sweden to 316 Spanish companies. Given the fact that in cross-national studies typically two to four countries are compared (Samiee and Jeong, 1994), our data base provides us with ample information to compare the innovation adoption patterns

across a relatively large number of countries. These countries represent a good mix of low and high context cultures, polychronic and monochronic cultures, and moreover they represent varying values on most of the Hofstede culture dimensions. In each country six industry sectors are involved (discrete & automotive industry, project industry, electronics industry, process industry, food & beverage industry and wholesale industry). The countries and industries were selected in cooperation with the sponsor of the research project, one of the main ERP software suppliers[2].

For this survey a pre-structured questionnaire was used, containing questions about the actual (1998) or planned (2000) adoption of ERP, and questions related to micro- and meso-variables. The questionnaire was developed in English and subsequently translated into the local languages by official translation agencies. For each country one trained native and English speaking research assistant was involved. Each checked the translation of the questionnaire, and discussed it with a local ERP vendor representative. Together they examined the questionnaire on possible flaws in interpretation and errors in the phrasing. Problems were solved after mutual consultations of all research assistants during a special meeting. This procedure ensures that the questionnaires were not suffering from translation biases. Precise measures of the variables used in our research model are given in Table 4.

The macro-level variables were added to the database afterwards, using secondary data sources. The scores on the Hofstede dimensions were based on Hofstede's IBM study (Hofstede, 2001). The scores on Hall's cultural dimensions were based on a study by Morden (1999) that ranked a number of countries worldwide on Hall's cultural dimensions, as shown in Tables 2 and 3. We used this ranking by giving a score to the various categories of countries, ranging from very low (=1) to very high (=16) context, from very monochronic (=1) to very polychronic (=20). We also made a binary variable by splitting the countries in low versus high context, and in monochronic versus polychronic cultures.

- Table 4 about here -

The sample procedure was as follows. The sample consisted of 60 segments derived from the ten European countries and six industries. These segments vary in size, as particular industries are more or less present in specific countries. Because random sampling across the segments (countries/industries) would yield low numbers for specific segments, for each segment a random sample of 45 observations was taken. A professional call center performed the actual sampling and telephone interviews. Random samples were drawn from local chamber of commerce databases containing addresses and names of responsible persons. The respondents were either IT managers or financial managers involved in IT purchase decisions. After the first cold call to the company, the call center used a maximum of 6 call-backs to reach the target person. This procedure yielded a reach percentage of 90% of the target persons, of which 44% was willing to take the interview. All interviews in our sample were completed, although of course there are missing values for some of the variables. The respondents were not informed about the name of the sponsor until the final part of the interview in order to avoid response bias.

[2] We thank the sponsor of the research project to share the data with us.

Results

Table 5 shows a number of descriptive statistics for the sample. For each country, the sample size of the survey is given as well as the ERP penetration levels in 1998 and 2000. Also, the scores on the culture dimensions of Hofstede and Hall for the ten countries included in this research are given. We start focusing on the first research question by analyzing the relation between those cultural variables and ERP penetration, and test hypotheses 1 to 7. Subsequently, we move on to the second research question, and analyze the added value of macro-level variables, in addition to the meso- and micro-level variables (hypothesis 8).

- Table 5 about here -

ERP penetration levels across the 10 countries

The penetration levels are calculated based on the number of companies that had adopted ERP in 1998 and the companies that had indicated to adopt before 2001. In this study a firm is said to be an adopter if it has standardized ERP software installed in one or more functional areas of the organization. The functional areas for which the respondents had to indicate if ERP is used (yes or no) were purchase and sales order management, inventory and materials management, production and assembly, transportation, service and maintenance, marketing and sales, warehouse management, financial accounting, and finally human resource management.
At the time of the survey (mid-1998) 34% of the companies in our sample had ERP software installed in one or more functional areas. With respect to expected penetration of ERP software (mid-2000), our estimations are based on investment indications by the respondents. Among the firms that did *not* have ERP on board many of them (overall 47%) had decided to invest in it within the next two years. Of course, it must be borne in mind that investment intentions are not necessarily equal to actual behavior, but one may cautiously estimate that, roughly 65% of the midsize companies in Europe were embracing ERP at the start of the new millennium.
As Figure 1 already showed, the data reveal some interesting differences between the countries. Apparently, in 1998, Denmark, Sweden and The Netherlands were far ahead with penetration rates above 45%, while UK, Finland and Spain were lagging behind with penetration rates less than 21%. The data also show that the penetration of ERP software was expected to grow especially in Finland and Norway, countries that showed relatively low 1998 adoption figures. Consequently, in 2000 the Nordic countries appear to have higher penetration levels than countries from the Southern part of Europe. Our premise is that certain macro cultural factors are at work here.

Relation between Hofstede's national culture dimensions and ERP penetration
Looking at the values of the Hofstede national culture dimensions in Table 5, the European countries can be characterized on average as highly individualistic, accepting mediate levels of power, rather feminine, rather uncertainty avoiding and finally, focusing on the short-term. However, strong variation exists in the values on these dimensions, especially for PDI, MAS, and UAI, across the ten countries. In order to test the influence of these cultural values on the ERP penetration levels we performed regression analyses (see Table 6). Due to problems of multicollinearity we

were forced to not include all five dimensions in the same multivariate regression analysis. Table 7 shows the correlation matrix of the cultural variables and reveals that the power distance index is closely correlated to the uncertainty avoidance index (.93), and also above .50 correlated to the masculinity index. Although the individualism index is not correlated above .50 with one of the other dimensions, the tolerance level was extremely low (.38) when included in the multivariate regression analysis, indicating problems of multicollinearity. Therefore we performed a separate regression analysis on PDI and IND in order to test their influence on the ERP penetration levels.

- Table 6 about here -

- Table 7 about here -

The results in Table 6 indicate a strong influence of national culture on ERP penetration levels, given the significant parameter values and the high R-square values for both analyses (.33 and .74 respectively .19 and .38). We found a significant negative influence of the uncertainty avoidance index (UAI), the masculinity index (MAS), and the power distance index (PDI). A significant positive influence on ERP penetration was found of the long-term orientation (LTO). Thus the higher the scores on UAI, MAS and PDI the lower the ERP penetration rate, and the higher the score on LTO the higher the ERP penetration rate. These results confirm hypotheses 1, 2 and 5.
An interesting result is the change in sign of the B-value of the influence of the individualism index on the ERP penetration in 1998 and 2000. First, a positive effect was found in 1998, which confirms hypothesis 3. The more individualistic a country, the higher the ERP penetration level. For the ERP penetration in 2000 we see, however, a negative influence of higher levels of individualism. Apparently, at early stages of the diffusion curve (1998 – penetration is 34%) individualism works positive in getting the diffusion process started, while at later stages of the diffusion curve (we calculated a 65% ERP penetration rate in 2000) the process seems to be accelerated in collectivistic cultures. This might be explained by the fact that the influence of personal networks is more important for later than for early adopters. In collectivistic cultures one makes decisions in consultation with colleagues, peers or friends, and tries to act conform the social norm. Thus, once the penetration becomes at a certain level, the penetration plafond might be reached sooner in collectivistic countries because in these countries innovation champions want to involve others, and innovations diffuse within existing networks, as was indicated in Table 1.
Finally, hypothesis 4, which suggested a positive effect of MAS, was contradicted. This unexpected negative influence of the MAS index might be explained by the specific nature of ERP systems which focus on sharing information within companies and working together, which are values that are generally associated more with feminine than masculine cultures.

Relation between Hall's low/high context and monochronic/polychronic cultures and ERP penetration
Table 6 also indicates the mean scores on ERP penetration in 1998 and 2000 for the low and the high context cultures, and the monochronic and polychronic cultures. Our data set includes three high context cultures. Two out of these three are also

characterized as polychronic cultures, according to the categorization between low and high, and between monochronic and polychronic as indicated in Tables 2 and 3.
The results of t-tests show that the low context and monochronic cultures have significantly higher ERP penetration levels than high context and polychronic cultures, which confirms hypotheses 6 and 7. Companies base their adoption decisions more on rational, economic arguments, and rely less on emotions. In other words, with respect to the adoption of a far-reaching innovation like ERP software, the content of messages about this innovation (low context cultures) seems to be more important to decision makers than the way these messages are communicated (high context cultures).

Table 8 summarizes the results of hypotheses testing. On the basis of the findings above, hypotheses 1, 2, 5, 6 and 7 can be confirmed, while for hypothesis 4 an opposite sign was found. Hypothesis 3 about the effect of individualism could only be confirmed for early adopters, while for later adopters a negative sign was found. Consequently, the answer to research question one is a definite yes, saying that national cultural variables can explain cross-national variance in the diffusion of an innovation.

- Table 8 about here -

ERP adoption decisions of individual companies

For testing the influence of the national cultural variables relative to the traditional meso- and micro-level variables the ERP adoption by European companies, we specified three logistic regression equations (see Table 9). The first equation includes only micro-level variables, the second equation includes both micro- and meso-level variables, while the third equation also includes three of Hofstede's national culture dimensions as explanatory variables. Due to problems of multicollinearity we were forced not to include all Hofstede and Hall cultural variables at the same time. Therefore separate analyses for the other Hofstede dimensions and Hall's dimensions are conducted and will be discussed below.
The dependent variable of concern is the adoption (yes/no) in 1998. We focus here on the 1998 adoption data, because this data reflects the actual adoption in an early stage in the various countries. The variation in adoption rates is larger here, which serves better for investigating the effects.

- Table 9 about here -

All three models significantly explain ERP adoption, but model III including national cultural variables in addition to micro- and meso-level variables appears to be the best model, with the highest R-square and the highest accuracy of predicting the adopters. These results confirm hypothesis 8, implying that it is very useful to add macro-level cultural variables to the traditional meso- and micro-level variables. Table 9 also shows the b-parameters, the standard errors (S.E.) and the significance levels for each

of the variables. Significant effects (p<=.05) are shown in bold. As can be seen from Table 9, all national culture variables have a significant effect on the adoption decision of companies, with a negative influence of the level of uncertainty avoidance and masculinity and a positive effect of the level of long-term orientation.
If we include the other two Hofstede dimensions as national cultural variables instead of the three variables in Table 9, we find a significant negative effect of PDI (b=-.02, S.E.=.00, Sign.=.00), but a non-significant effect of IDV (b=.01, S.E.=.01, Sign.=.11).
Subsequently, we performed two separate analyses in which we included the Hall low versus high context dimension and next the monochronic versus polychronic dimension instead of the Hofstede dimensions, while keeping all other variables unchanged. The results showed significant models with significant negative effects of both dimensions (b=-.47, S.E.=.12; Sign.=.00 respectively b=-.38, S.E.=.13, Sign.=.01), while the effects (signs and significance levels) of the other micro- and meso-level variables remain unchanged. This implies that companies in low context and monochronic cultures are more likely to adopt ERP systems than companies in high context and polychronic cultures, and confirms the findings in the previous section on country penetration levels.
To summarize, the answer to research question two is that our results strongly indicate the importance of including national culture dimensions in order to explain adoption decisions of companies across different countries. Moreover, the specific cultural variables chosen in this study, i.e. the national cultural frameworks of Hofstede and Hall are both very useful classifications for analyzing international innovation adoption and diffusion in a business-to-business context.

Conclusions and managerial implications

This study is one of the first large-scale empirical studies in a B2B setting, including a large set of countries, investigating the role of national culture in explaining cross-country differences in innovation penetration rates as well as the adoption behavior of companies operating in different national cultures. Our study provides both substantive conclusions about the effects of national culture dimensions on adoption of innovations by midsize firms as well as methodological conclusions about the inclusion of macro factors in multi-country adoption studies.
We formulated a number of hypotheses regarding the influences of various national culture factors, i.e. the well-known Hofstede dimensions and the national cultural dimensions of Hall (low versus high context cultures and monochronic versus polychronic cultures). Based on our data, which constitutes an exceptionally large set of observations from 10 different European countries, we found evidence in our data supporting most of the hypotheses. We can safely conclude that national culture does influence the cross-country ERP penetration levels, and moreover, the individual adoption behavior of companies operating in different national cultures. Higher levels of Hofstede's uncertainty avoidance, masculinity and power distance dimensions in a country negatively influenced the ERP penetration and the ERP adoption decisions of companies, while higher levels of long-term orientation have a significant positively influence. Also Hall's classifications into low vs. high context cultures and monochronic vs. polychronic cultures does have significant impact on the adoption behavior of firms and country penetration levels. From a methodological perspective our findings imply that multi-country research on adoption of innovation could benefit

from the inclusion of macro factors in the research model in addition to the traditional meso- and micro factors.

The results of our study also have important implications for suppliers of innovations who want to launch their product in multiple countries. An essential message, in particular for non-European countries, is that even within Europe large cultural differences exist that substantially affect the penetration levels of innovations. Overall, the Nordic European countries seem to be most receptive to breakthrough innovations (cf. ERP systems). Countries characterized by a high level of uncertainty avoidance and a low level of long-term orientation (cf. mediterranean countries) are less likely to adopt such innovations spontaneously. This information can help managers to decide on the best sequence of the international roll-out of their new products and systems. But, even more, it can help managers to adjust their communication and distribution strategies according to each country's cultural traits. For instance, in high context cultures messages about innovations may be managed effectively through transformational communications by testimonials, good practice examples and industry group meetings, while in low context countries informational communications via brochures, internet, and company visits could be the best way of getting the message of the innovation across.

Limitations and further research

As with any empirical research, this study has limitations. Firstly, although the sample is relatively large and includes various countries and industries, it is limited to a specific innovation (ERP software) and to these (Western European) countries. The role of national culture might be different for other innovations and especially for other market environments. Nevertheless we already found significant effects for most of our national culture variables, and therefore this limitation did not limit our main conclusion that it is important to take into account national cultural variables in addition to meso- and micro-level variables when explain adoption rates and behavior across countries. Future research could include other countries, worldwide, as to include more high context and polychronic cultures, as well as countries with a stronger variation and less correlation regarding the Hofstede dimensions. Also focusing on other innovations might reveal to what extent the unexpected negative influence of masculinity is due to the choice of a particular innovation.
Secondly, we make use of a database provided by one of the major ERP suppliers, which limits the inclusion of specific factors in the model to those included in the database and therefore some specific factors may be missed. We do not consider that it has limited us too much, however, because in this study we are not so much interested in establishing an exhaustive set of meso- and micro-level variables explaining adoption of ERP software, but rather in investigating the influence of macro-level variables relative to micro- and meso-level variables. It appears that including macro-level variables (in this case national cultural variables), in addition to micro- and meso-level variables does improve the model significantly. Consequently, in future cross-national research on the adoption of innovations it is strongly recommended to include national cultural variables.

References

Abrahamson, E., Rosenkopf, L., 1997. Social Network Effects on the Extent of Innovation Diffusion: A Computer Simulation. *Organization Science*, Vol. 8 No. 3 (May-June): 289-309.

Anderson, J.C., J.B.L. Thomson, and F. Wynstra. Combining value ond price to make purchase decisions in business markets. *International Journal of Research in Marketing* 17 (4): 307-329 (2000).

Baldwin, W.L. and J.T. Scott. *Market Structure and Technological Change*. Harwood Academic Publishers, Chur, Switzerland. 1987.

Czinkota, M.R., Ronkainen, I.A., 1998. *International Marketing*. The Dryden Press, 5th ed.

EOS Gallup Europe, 1999. The Situation of Telecommunication Services in The Regions of the European Union. *Website of the European Union: http://europe.eu.int/ISPO/infosoc/telecompolicy/en/EOStudy/Resid/2br.htm*

Frambach, R.T., Barkema, H.G., Nooteboom, B., Wedel, M., 1998. Adoption of a service innovation in the business market: an empirical test of supply side variables, *Journal of Business Research*, 41, 2, February: 161-174.

Frambach, R.T., Schillewaert, N., 2002. Organizational innovation adoption. A multi-level framework of determinants and opportunities for future research. *Journal of Business Research* Vol 55: 163-176.

Gatignon, H., Robertson, T.S., 1989. Technology Diffusion: An Empirical Test of Competitive Effects. *Journal of Marketing* 53 (1): 35-49.

Gauvin, S., Sinha R.K., 1993. Innovativeness in industrial organizations: a two-stage model of adoption. *International Journal of Research in Marketing* Vol 10 (No. 2): 165-183.

Hall, E.T., 1976. *Beyond Culture*. Garden City, NY: Anchor Press.

Hofstede, G., 2001. *Culture's Consequences*: *Comparing Values, Behaviors, Institutions, and Organizations Across Nations.* Sage Publications, second edition.

Kara, D., 1999. ERP integration. *Informationweek* March 8, 1999, 1a-6a.

Kimberly, J.R. and M.J. Evanisko, 1981. Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations. *Academy of Management Journal* 24 (4): 689-713.

Klaus, H., M. Rosemann ,and G.G. Gable, 2000. What is ERP? *Information Systems Frontiers* 2 (2): 141-162.

Kotabe, M., Helsen, K., 2001. *Global Marketing Management*. JohnWiley and Sons, 2nd ed.

Levin, S.G., Levin, S.L., and J.B. Meisel. A dynamic analysis of the adoption of a new technology: the case of optical scanners. *Review of Economics and Statistics* 69 (1): 12-17 (1987).

Link, S.G. and B. Bozeman. Innovative Behavior in Small-sized Firms. *Small Business Economics* 3: 179-184 (1991).

Lynn, M., Gelb B.D., 1996. Identifying innovative national markets for technical consumer goods. *International Marketing Review* Vol 13 (6): 43-57.

Montaguti, E., Kuester, S., Robertson, T.S., 2002. Entry strategy for radical product innovations: A conceptual model and propositional inventory. *International Journal of Research in Marketing* Vol. 19 (1): 21-42.

Morden, T., 1999. Models of National Culture – A Management Review, *Cross Cultural Management* 6 (1): 19-44.

Newell, S., Swan, J., Robertson, M., 1998. A cross-national comparison of the adoption of business process reengineering: fashion-setting networks? *Journal of Strategic Information Systems* Vol. 7: 299-317.

Png, I.P.L., Tan B.C.Y., Wee K-L., 2001. Dimensions of National Culture and Corporate Adoption of IT Infrastructure. *IEEE Transactions on Engineering Management* 48 (1):36-45.

Robertson, T.S. and H. Gatignon, 1986. Competitive effects on Technology Diffusion. *Journal of Marketing* 50 (1): 1-12.

Rogers, E.M., 1995. *Diffusion of Innovations.* New York: The Free Press, 4th ed.

Samiee, S., Jeong, I., 1994. Cross-cultural research in Advertising: An assessment of methodologies. *Journal of the Academy of Marketing Science* Vol. 22 (Summer): 205-217.

Shane, S., 1993. Cultural influences on national rates of innovation. *Journal of Business Venturing* Vol. 8: 59-73.

Steenkamp,J-B.E.M., ter Hofstede, F., Wedel, M., 1999. A cross-national investigation into the individual and national cultural antecedents of consumer innovativeness. *Journal of Marketing* Vol 53 (April): 55-69.

Sivakumar, K., Nakata, C., 2001. The Stampede Toward Hofstede's Framework: Avoiding the Sample Design Pit in Cross-Cultural Research. *Journal of International Business Studies*, 32 (3): 555-574.

Takada, H., Jain, D., 1991. Cross-National Analysis of Diffusion of Consumer Durable Goods in Pacific Rim Countries. *Journal of Marketing* 55 (April): 48-54.

Thong, J.Y.L., 1999. An integrated model of information systems adoption in small businesses. *Journal of Management Information Systems* 15 (4): 187-214.

Van Everdingen, Y.M. and G.J. Bamossy, 2000. Marketing of a Financial Innovation: Commercial use of the Euro by European companies prior to mandatory adoption. *Journal of Business Research* 48 (May): 123-133.

Yaveroglu, I.S., Donthu, N., 2002. Cultural influences on the diffusion of new products. *Journal of International Consumer Marketing* Vol 14(4): 49-63.

Zmud, R.W., 1982. Diffusion of modern software practices: influence of centralization and formalization. *Management Science* Vol 28 (December): 1421-1431.

Figure 1. Penetration development across countries

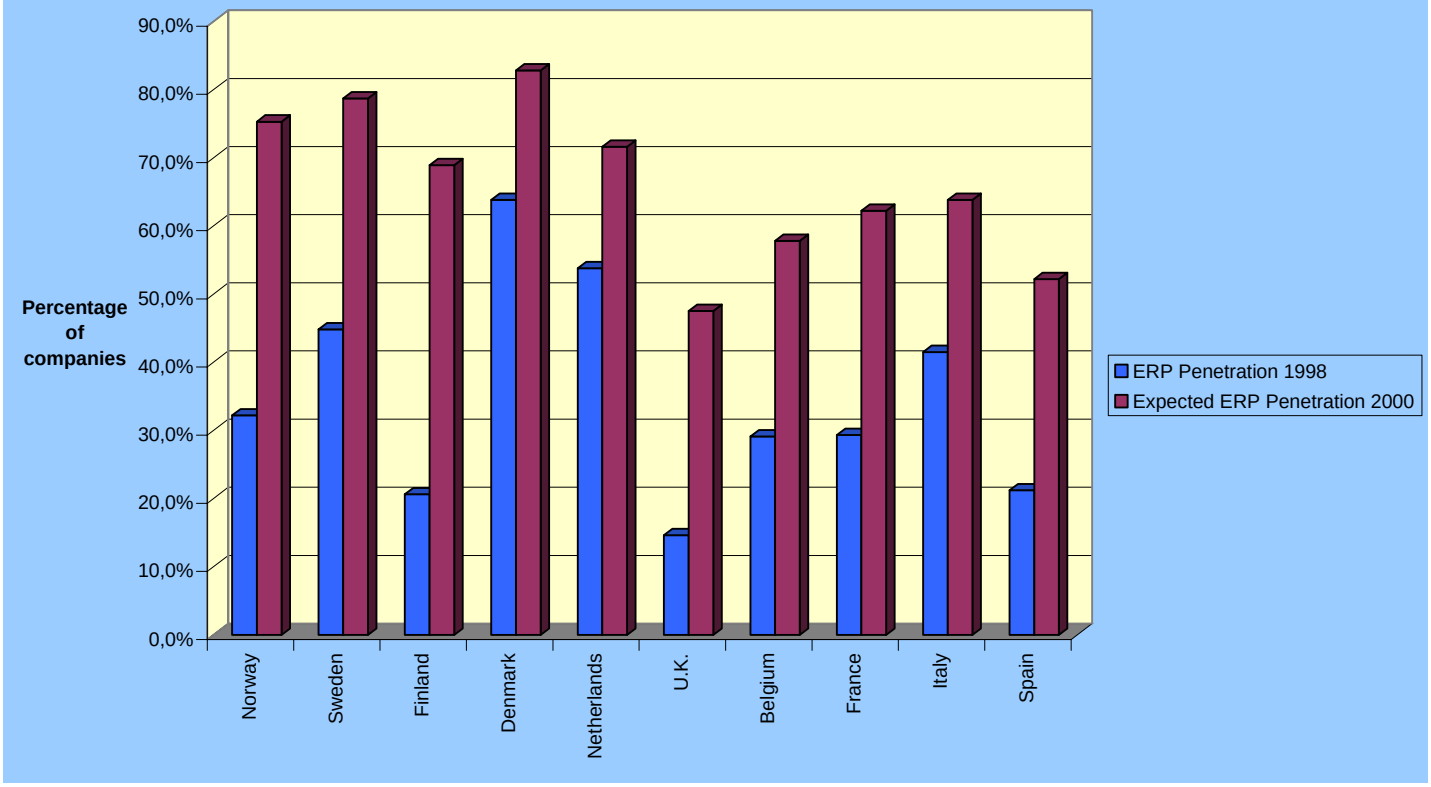

Figure 2 Conceptual Adoption Model

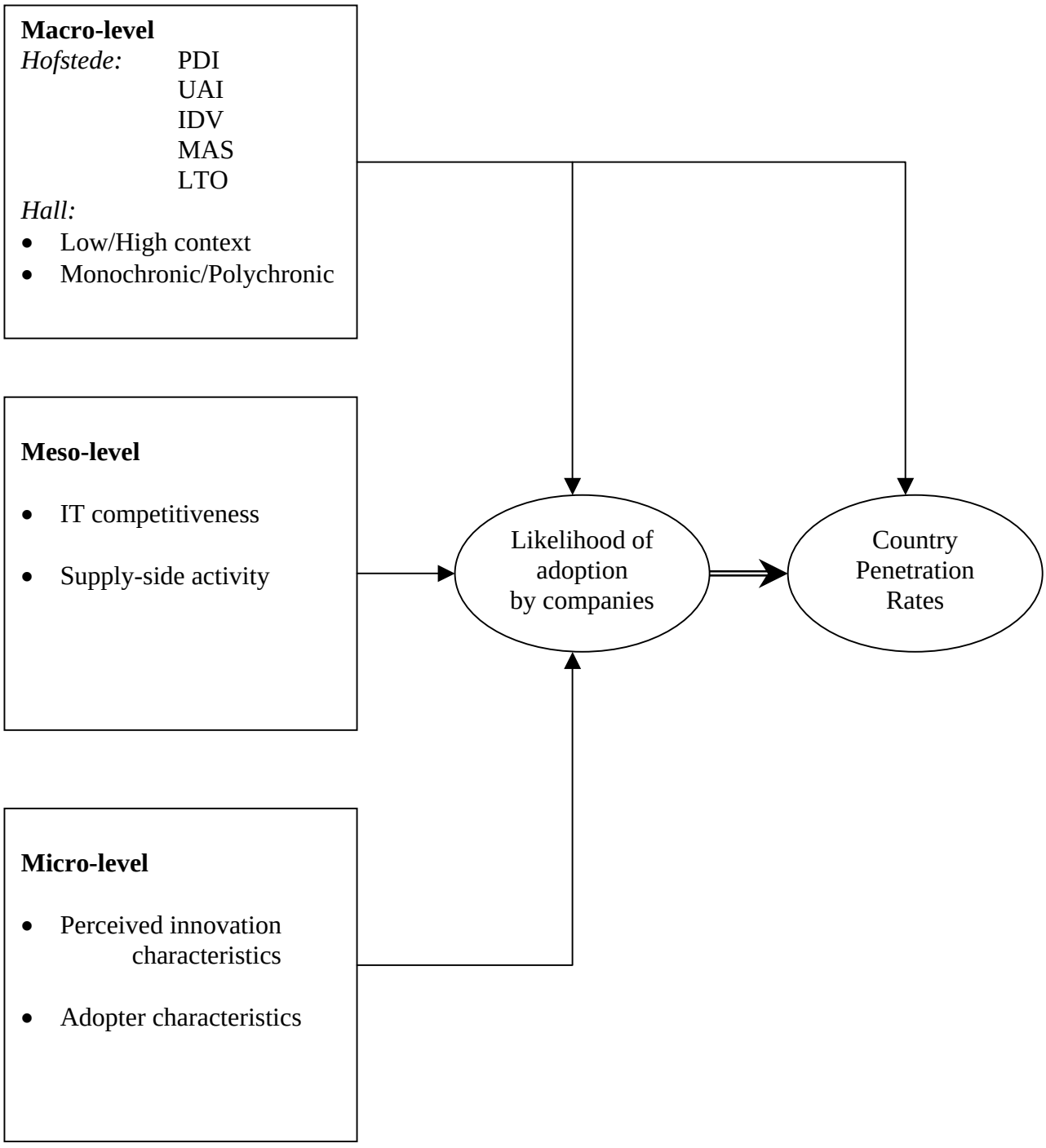

Table 1: Characteristics of companies with low / high scores on the Hofstede dimensions and the expected influence on the adoption of innovation (Hofstede, 2001).

	Low scores on dimension	*High scores on dimension*	*Expected Influence on adoption of innovations*
	Characterized by:	Characterized by:	
PDI Power Distance Index	Decentralized decision structures Flat organization Use of personal experience Subordinates expect to be consulted Innovations need good champions Managers involved in purchasing decisions	Centralized decision structures Hierarchy / authority Use of formal rules Subordinates expect to be told Innovations need good support from hierarchy Managers not involved in relevant purchasing decisions	Negative H1
UAI Uncertainty Avoidance Index	Skepticism toward technological solutions Innovators feel independent of rules Tolerance for ambiguity in structure and procedures Innovations welcomed but not necessarily taken seriously	Strong appeal for technological solutions Innovators constrained by rules Highly formalized conception of management Innovations resisted, but if accepted, applied consistently	Negative H2
IDV Individualism Index	Belief in collective decisions Innovation champions want to involve others Innovations within existing net-works Fewer invention patents granted Less social mobility across occupations	Belief in individual decisions Innovation champions want to venture out on their own Innovations outside existing networks More invention patents granted Greater social mobility across occupations	Positive H3
MAS Masculinity Index	Relations and working conditions Stress on equality, solidarity and quality of work life Managers expected to use intuition, deal with feelings and seek consensus Lower job stress	Security, pay and interesting work Stress on equity, mutual competition, and performance Managers expected to be decisive, assertive, aggressive, competitive Higher job stress	Positive H4
LTO Long-Term Orientation	Focus on short-term results: the bottom line. Short-term virtues taught	Focus on building relationships and market position Long-term virtues taught	Positive H5

Table 2: Low and High context countries and their characteristics

	Scale score	*Countries*	*Characteristics*	*Expected influence on adoption of innovations*
Low context	1	Germans, Swiss, Austrians	• Message is made explicit • Interpretation of messages rests on the written or spoken word – focus on content • Seek information from a research base (reports, databases, internet, etc.)	Negative H6
	2	New Zealanders, (white) South Africans		
	3	North Americans (white Anglo-Saxon Protestant) and Canadians		
	4	Scandinavians, Finns		
	5	British, Australians		
	6	Benelux people		
	7	Other American cultures		
	8	Slavs		
	9	Central Europeans	• Interpretation of messages rests on contextual cues • Seek information from personal information networks • Becoming well-informed about the facts before making a decisions	
	10	Koreans, South East Asians		
	11	Indians, and other Indian sub-continent		
	12	Arabs, Africans		
	13	Latin Americans		
	14	Italians, Spanish, Portuguese, French, Other Mediterranean peoples		
High context	15	Chinese		
	16	Japanese		

Based on Morden, 1999; Usunier, 2000; Kotabe and Helsen, 2001.

Table 3: Monochronic and Polychronic countries with their characteristics.

	Scale score	*Countries*	*Characteristics*	*Expected influence on adoption of innovations*
Mono-chronic	1	Germans, Swiss, Austrians	• Plans ahead methodically • Does one thing at a time • Punctual • Sticks to plans • Sticks to facts • Gets info from statistics, reference books, database • Works within department • Focused communication, to the point • Writes memoranda, uses written record	Negative H7
	2	Americans (White Anglo-Saxon Protestant)		
	3	Scandinavians, Finns		
	4	British, Canadians, New Zealanders		
	5	Australians, (white) South Africans		
	6	Japanese		
	7	Dutch, Flemish Belgian		
	8	Other American cultures		
	9	French, Walloon Belgium		
	10	Koreans, Taiwanese, Singaporeans		
	11	Czechs, Slovakians, Slovenians, Croats, Hungarians	• Plans grand outline / "vision" • Does several things at once • Unpunctual • Changes plans • Juggles facts • Gets first-hand oral information • Goes round all departments • Talks for hours • Dislikes writing too much, prefers flexibility to commitment	
	12	Chines		
	13	Northern Italians		
	14	Chile		
	15	Other Slavs		
	16	Portuguese		
	17	Spanish, Southern Italians, Other Mediterranean people		
	18	Indians, and other Indian sub-continent		
Poly-chronic	19	Polynesians		
	20	Latin Americans, Arabs, Africans		

Based on Morden, 1999; Kotabe and Helsen, 2001.

Table 4: Variables and Measures.

Variables	Measures
Dependent variable	
Adoption of ERP (1998)	ERP software present in one or more functional areas of the firm (no/yes) (at the time of this survey, 1998)
Planned Adoption of ERP (2000)	plans to invest in ERP software in one or more functional areas within two years (no/yes for current non-adopters)
Meso-level independent variables	
Industry IT competitiveness	average increase/decrease in budgets devoted to information systems across all companies in the country/industry
Supply-side activity (of ERP suppliers)	spontaneous awareness of ERP suppliers in the country/industry (recalled one or more=1; recalled none=0)
Micro-level independent variables	
Innovation characteristics	
Advantages of ERP	importance-ranking of best new technology, fit with current procedures, implementation period (0 not mentioned; 3 most important).
Adopter characteristics	
Attitude towards IT innovation	IT conservative (1), IT mainstream (2), or IT pioneer (3)
Level of IT integration	extent to which information processes are optimally tuned to each other (1 low integration; 5 high integration)
Yearly resources devoted to IT	yearly IT budget ($\$10^6$) / number of employees

Table 5: ERP penetration 1998 and 2000; National Culture dimensions: Hofstede, Hall.

	ERP Survey			*Hofstede culture dimensions*					*Hall*		*Hall*	
Country	***Sample size***	***ERP penetration 1998 (%)****	***ERP penetration 2000 (%)****	***IND***	***PDI***	***MASC***	***UAI***	***LTO***	***Low/High Context Culture***	***Scale value (1=very low; 16=very high)***	***Monochronic Polychronic Culture***	***Scale Value (1=very mon.; 20=very poly)***
Belgium	251	29	58	75	65	54	94	38	Low	6	Monochronic	8
Denmark	232	64	83	74	18	16	23	46	Low	4	Monochronic	3
Finland	228	20	69	63	33	26	59	41	Low	4	Monochronic	3
France	304	29	62	71	68	43	86	39	High	14	Monochronic	9
Italy	282	41	64	76	50	70	75	34	High	14	Polychronic	15
Netherlands	275	54	72	80	38	14	53	38	Low	6	Monochronic	7
Norway	239	32	75	69	31	8	50	44	Low	4	Monochronic	3
Spain	316	21	52	51	57	42	86	19	High	14	Polychronic	17
Sweden	221	45	79	71	31	5	29	22	Low	4	Monochronic	3
United K.	301	15	48	89	35	66	35	35	Low	5	Monochronic	4
All countries	2649	34	65	72	43	34	59	36	-	7,5	-	7,2

Source: ERP Survey; Hofstede, 2001; Morden, 1999.

* Calculated based on the number of companies in the sample that had adopted ERP in 1998.

** Calculated based on the number of companies that had ERP on board in 1998 plus the number of companies that did not yet have ERP but indicated to have plans to invest in ERP within the next two years.

Table 6: ERP Penetration levels explained by national culture variables.

Variables	**ERP penetration 98**			**ERP penetration 2000 (expected)**			
Hofstede culture dimensions							
Multivariate Regression analysis	B	S.E.	Sign	B	S.E.	Sign	Tol
Uncertainty Avoidance Index	-.18	.00	**.00**	-.13	.00	**.00**	.76
Masculinity	-.40	.00	**.00**	-.70	.00	**.00**	.78
Long-Term Orientation	.19	.00	**.00**	.27	.00	**.00**	.95
R-square	.33			.74			
Multivariate regression analysis							
Power distance	-.39	.00	**.00**	-.64	.00	**.00**	.93
Individualism	.10	.00	**.00**	-.17	.00	**.00**	.93
R-square	.19			.38			
Hall cultural context							
t-test on means							
Low context cultures	.36			.68			
High context cultures	.30			.59			
t-value (sign. level)	10.91 (**.00**)			22.13 (**.00**)			
t-test on means							
Monochronic cultures	.35			.67			
Polychronic cultures	.30			.58			
t-value (sign. level)	7.18 (**.00**)			20.45 (**.00**)			

Table 7: Correlation matrix: Penetration levels and national culture characteristics

	ERP98	ERP00	IND	PDI	MASC	UAI	LTO	Low/High	Mono/Poly
ERP penetr98	1.00	.80	.20	-.42	-.51	-.40	.28	-.21	-.18
ERP penetr00		1.00	-.00	-.60	-.80	-.51	.40	-.46	-.51
IND			1.00	-.26	.25	-.44	.46	-.39	-.46
PDI				1.00	.54	**.93**	-.29	**.75**	**.68**
MASC					1.00	.47	-.15	.53	.53
UAI						1.00	-.21	**.72**	**.73**
LTO							1.00	-.42	-.57
Low/High								1.00	**.90**
Mono/Poly									1.00

Table 8: Summary of testing the hypotheses 1 to 7.

Cultural variable	**Hypothesized influence on country penetration**	**Results**
Hofstede:		
1. Power Distance Index (PDI)	Negative	Confirmed
2. Uncertainty Avoidance Index (UAI)	Negative	Confirmed
3. Individualism Index (IDV)	Positive	Confirmed for early adopters, negative influence for later adopters
4. Masculinity Index (MAS)	Positive	Negative influence
5. Long-term Orientation (LTO)	Positive	Confirmed
Hall:		
6. Low / high context cultures	Negative	Confirmed
7. Monochronic / polychronic cultures	Negative	Confirmed

Table 9: Results of logistic regression analyses (Dependent variable: yes / no adoption in 1998).

	Model I: micro variables			**Model II: micro, meso variables**			**Model III: Micro, meso, macro variables**		
	B	*S.E.*	*Sign.*	*B*	*S.E.*	*Sign.*	*B*	*S.E.*	*Sign.*
Company characteristics									
Attitude toward IT innovation	.19	.08	**.01**	.20	.08	**.01**	.17	.08	**.03**
Level of IT integration	.26	.05	**.00**	.27	.05	**.00**	.27	.05	**.00**
IT budget / employee	.44	.27	.10	.12	.28	.66	.31	.29	.28
Perceptions of innovation char.									
Importance of:									
• Best new technology	.14	.08	.10	.09	.09	.29	.14	.09	.11
• Best fit	-.16	.04	**.00**	-.14	.04	**.00**	-.13	.04	**.00**
• Implementation period	.06	.10	.51	.02	.10	.87	.09	.10	.39
Industry sector (ref.cat= wholesale)						**.00**			**.00**
• Automotive				.30	.18	.09	.32	.18	.08
• Electronics				.47	.20	**.02**	.63	.20	**.00**
• Food & Beverage				.12	.22	.59	.44	.23	**.05**
• Process industry				.07	.19	.70	.14	.20	.47
• Project industry				-.37	.20	.07	-.38	.21	.07
IT competitiveness in sector				.01	.01	**.05**	.01	.01	.12
Supply-side activity				.75	.11	**.00**	.79	12	**.00**
Culture dimensions (Hofstede)									
Uncertainty Avoidance							-.01	.00	**.00**
Masculinity							-.01	.00	**.00**
Long-Term Orientation							.02	.01	**.00**
Model Chi-square	66,491 (d.f.=6) (p=.00)			142,22 (d.f. 13) (p=.00)			207,89 (d.f. 16) (p=.00)		
Nagelkerke R-square	.05			.11			.16		
% adopters correctly classified	7,11%			23,74%			32,06%		

Publications in the Report Series Research* in Management

ERIM Research Program: "Marketing"

2003

The Effect of Members' Satisfaction with a Virtual Community on Member Participation
Fred Langerak, Peter C. Verhoef, Peeter W.J. Verlegh, Kristine de Valck
ERS-2003-004-MKT

Surprise … Surprise, An Empirical Investigation on How Surprise is Connected to Customer Satisfaction
Joëlle Vanhamme
ERS-2003-005-MKT

Differentiated Bayesian Conjoint Choice Designs
Zsolt Sándor, Michel Wedel
ERS-2003-016-MKT

A multi-country study of the adoption of ERP systems: The effect of national culture
Yvonne M. van Everdingen, Eric Waarts
ERS-2003-019-MKT

---

* A complete overview of the ERIM Report Series Research in Management:
http://www.ers.erim.eur.nl

ERIM Research Programs:
LIS Business Processes, Logistics and Information Systems
ORG Organizing for Performance
MKT Marketing
F&A Finance and Accounting
STR Strategy and Entrepreneurship