



# E-procurement adoption by European firms: A quantitative analysis

Ronald Batenburg

*Department of Information and Computing Sciences, Utrecht University, P.O. Box 80089, 3508 TB Utrecht, The Netherlands*

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## Abstract

We explore country differences in adoption of electronic procurement. Data are used from the EU-initiated e-Business W@tch survey 2003. Analyses are conducted on 3475 organizations from seven different European countries that were stratified according to nine different sectors and three size categories. It appears that there indeed are country differences with respect to e-procurement adoption, and that firms from countries with a low uncertainty avoidance such as Germany and the UK are the early adopters of e-procurement, while countries that are less reluctant to change such as Spain and France have lower adoption rates.

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## 1. Introduction

Research in purchasing and supply management should become much more quantitative than it is now. I have two main reasons for this. The first one is that in any science, there should be a balance between the soft and the hard, the prescriptive and the descriptive, and the richness of details versus the generality of statistics. In purchasing research there is a abundance of qualitative studies and we need a bit of counterweight to the qualitative stream of research. The second reason is that our discipline is still young: we actually need to have more quantitative facts to talk about. Otherwise, theorizing in purchasing research is playing the air guitar over and over: all moves but no sound. Science rightly starts from imagination and amazement: “I just saw this happen, how can that be?” In social sciences such as ours, it should be a fundamental target to investigate first whether the amazing feat that we saw is indeed an interesting empirical regularity or just a remarkable but rare coincidence.

For me, the best way help the discussion on the issue is to provide quantitative studies. It will have strong and weak points that are characteristic for its kind. My driver is that the strong points outweigh the weak points. But you can decide for yourself.

The adoption of IT or information systems is often interpreted as a single or isolated act of purchasing an application. Obviously, this is a simplification of the common notion that the initial purchase of IT is often the start of an extensive trajectory of implementation, deployment, and alignment that significantly effects the adopting organization (cf. Gopalakrishnan and Damanpour, 1994; Mabert et al., 2002). The starting point of this paper is that the adoption of e-procurement is no exception. While the opportunities and threats of e-procurement seem to wave along with the commercial exposure of IT-consulting companies and related media interests, user organizations face complex deliberations whether to go along with this step to digitalize their purchase and procurement function (Davila et al., 2003). The organizational decision to adopt e-procurement is commonly taken by boards and managers who take information about both the alternatives and the consequences into account. To set one important scope of this study, we focus on this kind of decision making and its variation *between* organizations. Consequently the adoption decision *within* organizations is neglected, including issues such as the acceptance of e-procurement by users (Rogers, 1983; Bouwman et al., 2005). In addition, we limit this study by focusing on the conditions of e-procurement adoption instead of its potential objectives. In particular, we aim to understand the role of national characteristics as

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*E-mail address:* [ronald@cs.uu.nl](mailto:ronald@cs.uu.nl)

one particular condition that might influence the likelihood of adoption. Interest in cross-national differences for IT adoption and procurement have started to emerge, but so far little or no empirical studies have been done on e-procurement as the combination of both. Although reports and normative studies about “world class purchasing” and “purchasing excellence” emphasize the importance of international comparisons through benchmarking (Boodie et al., 2002), more profound empirical indicators for procurement levels across countries is needed. With the rapid and world-wide increase of Internet and web-based application in organizations, the emergence of e-procurement (or: on-line purchasing) has become an interesting and distinctive performance indicator. In addition, existing research on country differences in the adoption of IT and ICT in general can assist in explaining differences in the adoption rate and pace.

In the following section we indicate and understand the potential effect of country characteristics on the e-procurement adoption of organizations. First, I elaborate on some theoretical expectations on cross-national differences in the next section. Then, a large-scale dataset that results from a international survey among European organizations is introduced. This survey, initiated by the European Community under the label “e-Business W@tch,” is used to describe and explain the e-procurement adoption of companies from seven different European countries around 2003. Before doing so, the influence of industry (and company) size is explored as a prominent background determinant of e-procurement. The final, “controlled” cross-national analysis of e-procurement adoption is then presented and expectations are evaluated. The last section closes with summary and suggestions.

## 2. Theory and expectations

Around 2000, when the adoption of IT and especially web-based applications was booming, Krumbholtz et al. (2000) studied the impact of culture on the implementation of Enterprise Resource Planning (ERP) in organizations. They used a case study to investigate the implementation of a German ERP package in a large pharmaceuticals company in Scandinavia and the UK. It was suggested that many of the ERP implementation problems are related to issues of (corporate) culture, especially when there is a mismatch of core values. They could not find a direct link between national culture and these implementation problems however.

The study by Krumbholtz et al. is one of the many practical examples that express the acknowledged, but (so far) hardly addressed question about the cross-national and cross-cultural aspects of ICT in business. In the context of this paper, we basically point to the question why organizations would in, say, Belgium, differ in their use of e-procurement software from, say, Finland. Most of the academic research that is conducted in the field of international comparison of organizations, international

management, or cross-cultural studies, are focusing on the country differences as such (Kirkman and Law, 2005). Indeed, these are of direct relevance if firms wish to expand their business to new markets, or if they consider opening a distribution center in a certain country, or are thinking about outsourcing their IT activities to a certain area. Consequently, much attention has been paid to the specific nature of doing business abroad, including extensive advises and consultancy on how to deal with customers, suppliers, business partners, governmental agencies, and so on. This mainstream of research is of limited use when we aim to understand the underlying principles of country differences. Indeed, it might be the case that Germans are known about their punctuality, and British about their politeness (to quote some common sense notions), but what does it tell about the decision making behavior of these inhabitants of Europe?

The most cited author in the research of international differences is obviously Hofstede (1980, 1991) who claims that national culture can explain half of the differences between managerial values, attitudes, and beliefs. Based on his classic study at IBM among 116,000 managers between 1967 and 1974, Hofstede scored over 70 countries on five basic dimensions: power distance, uncertainty avoidance, individualism versus collectivism, masculinity versus femininity, and long-term versus short-term orientation. Although extensively cited and used, Hofstede’s work was criticized also by (among others) Mintzberg et al. (1989) who emphasized the severe limitations of the original study (for instance, measurements were taken during the 1970s and among IBM managers only). More recent publications and statistics provided by Hofstede (2002) however, show that for 74 countries and regions the IBM study has been replicated and extended since 2001, using different international populations (including “commercial airline pilots”, “students”, “civil service managers”, “up-market consumers”, and “elites” in a varying number of countries), which suggests that the original results do not seem to depend much on Hofstede’s original choice of IBM managers.

Van Everdingen and Waarts are among the few scholars who used Hofstede’s typology to empirically study cross-national differences in the adoption of IT (Van Everdingen and Waarts, 2003). Using data from over 200 respondents from ten European countries and six main industry sectors, they studied the adoption of ERP systems around 1998, including the intention of firms to adopt before 2003. Van Everdingen and Waarts indeed found a significant relationship between Hofstede’s cultural values and ERP adoption. Companies from countries with (1) lower scores on power distance, (2) lower scores on uncertainty avoidance, and (3) higher scores on long-term orientation, had larger probabilities of adopting ERP. These relationships were hypothesized earlier by the authors through reasoning that: (1) power distance is characterized by centralization but ERP will not help to achieve this, (2) uncertainty avoidance is characterized by being risk adverse but ERP adoption is

very risky in terms of its complexity, costs, and insecure return on investment, and (3) long-term orientation is characterized by attention on the future and (indeed) ERP adoption plays a key role in future business success. The strength of these arguments as put forward by Van Everdingen and Waarts to connect cultural dimensions to ERP can be criticized, but the similarities between ERP and e-procurement are evident. In terms of investments and organizational control, e-procurement is of much lesser impact and scope than ERP. The two types of ICT are quite similar, however, with respect to the general uncertainty that accompanies such new technological applications (Davila et al., 2003; Yen and Ng, 2002). If we assume that countries do not differ with respect to the information about the potential risks, costs and benefits of e-procurement that is available for managers, then it can be hypothesized that organizations based in countries with high uncertainty avoidance scores have low e-procurement adoption rates.

One important limitation of Hofstede's study is the omission of the former communist countries. This is of interest because these nations have recently become member of the European union, and for that reason they are represented in the e-Business W@tch data that will be used later on in this paper. Au (1999) faced similar problems when he used the World Value Survey 1990, a cross-national study on intra-cultural variation (ICV) among 43 countries. Au brought both mean and standard deviations together for six variables related to work and change related topics from the World Values Survey conducted in 1990. These variables or items were formulated as "pride in work," "job satisfaction," "freedom in decision making," "change is good," "new ideas is good," and "welcome new ideas." To stay in line with the previous reasoning and Hofstede's classification, we focused on the "change is good" value of Au as closest to Hofstede's uncertainty avoidance dimension. Hence, we hypothesize that countries that have high scores on Au's "change" and "new ideas" also hold high scores on e-procurement adoption by their homebased organization. We once again need to assume that the novelty of e-procurement is comparable for countries.

One important presumption behind linking cultural scores to the behavior of individuals or organizations is that the variation of the cultural values within countries is smaller than between countries (Lim and Firkola, 2000). A particular strength of his classic study at IBM was exactly that the managers interviewed all dealt with the same central head office policy, i.e. the origin of the US-based mother company. As we will show in the next section, the dataset we use was not organized in such a "semi-experimental" setting. Given that the data are collected among managers from firms that are mainly national-based, oriented, and managed, we assume that country characteristics determine norms and beliefs of actors through socialization and institutionalization (Sirmon and Lane, 2004). To put it in another way, we follow

Calori et al. (1997), in the sense that we assume that organizational cultures are systematically shaped by national cultural differences through the firm's managerial legacy. This legacy can be defined as attitudes towards business procedures and priorities (Bigoness and Blakely, 1996) and managers' conceptualization of human nature, language, time, work, relationships, and space. The organizational or authoritative decision to adopt e-procurement is considered as a result of these attitudes and conceptualization.

### 3. The e-Business W@tch data set

The e-Business data were collected through telephone (CATI) interviews with IT managers, first in June–July 2002 in all member states of the European Union at that moment (i.e. Austria, Italy, Belgium, Luxemburg, Denmark, The Netherlands, Germany, Portugal, Finland, Spain, France, Sweden, Greece, UK, and Ireland). In this first round, a total 9264 companies participated. In March and November 2003, the second wave of interviews was held among the same 15 European countries, including Norway and the 10 new UE member states (Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovenia, and Slovakia). This round comprised 9794 responses. Because the 2003 wave included specific items about the year of adoption and implementation of e-business applications (including e-procurement), this dataset is chosen for analysis in this paper.

Field work of the e-Business W@tch project was executed by national market research organizations. The standard procedure for each country was to sample enterprises that "were active at the national territory of the country," "have their primary business activity in one of the sectors specified by NACE categories," and "can be defined as a business organization of one or more establishments comprised as one legal unit" (E-Business W@tch, 2004). Each national sample was drawn from "acknowledged business directories and databases" and stratified by economic activity (one or more of the 15 NACE-defined economic sectors, see below) and employee size. Size was of specific importance for stratification because the e-Business W@tch survey particularly aims to estimate the accurate level of usage and adoption of IT for countries and industries. It goes without saying that company size is strongly correlated with many IT needs and investments because of scale and scope of activities. In practice, three employee size strata were defined for each country and industry: to include a share of at least 10% of large companies (250 employees or more), 30% of medium sized enterprises (50–249 employees), and 25% of small enterprises (10–49 employees). Consequently, the so-called "micro-enterprises" with less than 10 employees were also included (by 35%).

Due to specific interest of the EU project and some practical restrictions, not every industry was surveyed in each country. In Cyprus, Lithuania, and Malta for

instance, only companies from one sector (the electrical machinery and electronics industry, or the transport equipment industry) were interviewed. In other countries, the number of industries varied between 2 and 11. The following table presents an overview of the 2003 dataset by country, size, and industry category responses.

As we wanted to have a reasonable spread in the sectors involved in the study per country, we decided to select the countries that had data from all 9 industries (Estonia, Poland, Spain, France, Germany, Italy, and the UK), denoted in Table 1 as the bottom part of the table. The total number of Estonian and Polish companies is lower compared to the other 5 countries, but the (proportional) industry composition is roughly equal for all 7 countries. In total, this subset contains 5333 out of the original 9137 cases, i.e. 58% of the total e-Business W@tch 2003 dataset. On face value, this spectrum of both countries and

industries appears to be sufficiently diverse according to national level of economic development, geographical spread, manufacturing versus service-oriented industries, and so on.

Unfortunately, response rates are not published by the e-Business W@tch reports. It is stated however, that “the main challenge was the fulfillment of quotas regarding company size-bands” and “dedicated ICT professional are heavily researched and therefore securing their participating can be difficult” (E-Business W@tch, 2004, pp. 237–238). Although “no major problems were reported by the fieldwork organizations with respect to the interviewing (...),” it is also reported that some survey questions were not relevant for companies with only a few employees, or could not be answered if the general manager was the respondent. Considering that we focus on e-procurement as a specific e-business application it was

Table 1  
Responses on the e-Business W@tch dataset 2003 by country and industry

Country	Industry									Total
	Chem	ICT	Health	Textile	Electr	TransEq	BusSer	Touris	Retail	
Cyprus									63	63
Lithuania									54	54
Malta								51		51
Norway				30					70	100
Hungary					76	77	80			233
Latvia	42			28					37	107
Austria			99			67		132		298
Belgium	98						100		94	292
Denmark			65					66	66	197
Finland		76		70	74					220
Ireland	69	71						62		202
Netherlands		101	101	93						295
Portugal						95	100		100	295
Slovakia				48	45		58		47	198
Sweden	80				75	76	80			311
Czech Republic	59	60	60			59		59		297
Slovenia		53	54		56		58	51		272
Greece				82	76	88		73		319
Estonia	50	50	49	47	50	21	49	49	47	412
Poland	75	77	69	61	75	68	75	72	70	642
France	98	99	97	86	99	96	98	79	84	836
Germany	97	100	99	95	100	98	100	98	89	876
Italy	100	101	92	84	101	98	100	102	98	876
Spain	98	100	95	93	99	97	100	99	94	875
UK	96	99	81	90	99	88	98	92	73	816
Total	962	987	961	907	1025	1028	1096	1085	1086	9137

Description of the industry abbreviations:

Chem, manufacture of chemicals and chemical products (NACE-code 02D–24,25);

ICT, telecommunications and computer-related services (NACE-code 09I/K–64.2, 72);

Health, health and social services (NACE-code 10N–85.11,85.12,85.3);

Textile, manufacture of textiles, textile products, leather, and leather products (NACE-code 01D17,18,19);

Electr, manufacture of Electrical machinery and electronics (NACE-code 03D–30,3 (except 31.3–31.6),32);

TransEq, manufacture of transport equipment (NACE-code 04D–34,35);

BusSer, business services (NACE-code 08K–74);

Touris, tourism (NACE-code 07H/I/O– 55.1,55.2,62.1,63.3,92.33,92.52,92.53);

Retail, retail (NACE-code 06G– 52.11,52.12,52.4).

decided to exclude the smallest firms (less than 10 employees) from the analysis. This reduces the subset to a total of 3475 firms. Table 2 illustrates that all 7 countries within

this subset are roughly equal in terms of composition with respect to size of the firm.

#### 4. Measuring e-procurement

The e-Business W@tch survey contains diverse information about the adoption, use, and implications of several types of information systems and applications. With regard to the use of e-procurement, one basic selection question was asked, followed by items that specify (1) the extent and channels of on-line purchasing and (2) the history of e-procurement use. Table 3 presents these survey questions and answer categories, including the frequency scores of all firms with 10 employees or more representing the 7 countries and 9 industries in our total subset. To take the effects of size and industry stratification as described in the previous section into account, we present both the unweighted and weighted frequencies. In the latter case, we

Table 2  
Responses on the e-Business W@tch dataset 2003 by country and size

Country	10–49 Employees	50–249 Employees	250 Employees or more	Total
Estonia	111	125	35	271
Poland	166	214	70	450
France	162	272	83	517
Germany	187	270	90	547
Italy	227	267	93	587
Spain	215	271	90	576
UK	174	265	88	527
Total	1242	1684	549	3475

Table 3  
Original questions, answers, and weighted/unweighted frequencies of e-procurement items in a subset of the e-Business W@tch dataset 2003

Original question	Original categories	Answer	Unweighted frequency in %	Weighted frequency in %
“Does your company use the Internet or other online services to purchase goods or services?” (N = 3475)		Yes	43.5	46.8
		No	54.9	51.8
		Don't know	1.6	1.4
“Do you order from websites of other companies?” (N = 1511)		Yes	85.6	87.7
		No	12.6	10.8
		Don't know	1.8	1.5
“Do you place orders on special electronic marketplaces on the Internet” (N = 1511)		Yes	23.0	22.0
		No	72.7	74.3
		Don't know	4.2	3.7
“Do you order goods or services through access to the extranet of a supplier?” (N = 1511)		Yes	29.1	27.4
		No	66.0	67.7
		Don't know	5.0	4.9
“Is your IT system integrated with that of a supplier for placing orders?” (N = 1511)		Yes	17.1	15.2
		No	79.9	82.2
		Don't know	2.9	2.6
“Please estimate how large a share of your total purchases is conducted online. Would you say...” (N = 1511)		More than 50%	6.2	5.7
		26 up to 50%	6.4	7.1
		11 up to 25%	11.5	12.8
		5 up to 10%	19.5	20.7
		Less than 5%	50.3	48.6
		Don't know	6.2	5.0
“When did your company purchase goods or services online for the first time? If you don't know it exactly, could you please give your best possible estimate?” (N = 1511)		2003	4.4	4.2
		2002	15.7	14.8
		2001	23.6	22.0
		2000	19.4	19.8
		1999	8.7	8.8
		1998	7.5	7.8
		1997	2.4	2.4
		1996	1.3	1.2
		1995	1.1	1.0
		1994 or earlier	1.5	0.5
		Don't know	14.6	17.0

used the weighting as provided by the e-Business W@tch researchers that were based on population data with regard to sizes of firms in terms of full-time equivalents by Eurostat. The weighting cells are “uniform expansion factors that are applied to enterprises within one of the four size classes per industry per country” (E-Business W@tch, 2004, pp. 239–240).

A majority of the 1511 firms who say they apply e-procurement use the suppliers’ website to order electronically. The other channels of e-procurement (e-marketplaces, extranets, or buyer-integrated order systems of suppliers) are used by minorities of these firms. With respect to e-marketplaces, this result is in line with the observations of Eng (2004). On average, the share of total purchases conducted online is limited, i.e. 5% or less. In fact, this proportion is equal to what has been defined as a “pilot” level for organizations that aim to start with e-procurement (Rajkumar, 2001). Another indicator of the progress in e-procurement within this group is the year in which they purchased through online services for the first time. As can be expected, the answers indicate that the phenomenon is relatively new. A large majority of organizations started to apply e-procurement in 2000, or just 1–2 years ago (assuming that after the first time it will actually be continued).

It can be expected that the above indicators to measure the scope, extent, and history of e-procurement are positively interrelated. Empirically we see this as all Spearman rank–order correlations—to take the categorical non-interval nature of most variables into account—between the variables are significant at the 5% level. The correlation coefficients, varying between +.06 and +.17, appear to be not very strong however. Factor and scale analysis confirm that the e-procurement indicators cannot be aggregated (modeled) into one or two latent factors. Consequently, the presented variables will be used simultaneously in analyzing their relationship with the subsequent determinants.

#### 4.1. Size and industry as determinants of e-procurement

Since the seven different countries in our subset are equally composed by size and industry through stratification, our first step is to investigate the effect of these background characteristics before going into the country differences. Doing so, one realizes that both size and industry are heterogeneous proxies for a large and diverse number of factors or conditions that potentially determine the extent and history of e-procurement.

We recall from the classic study of Rogers (1983) that larger organizations are more innovative. Here, size (i.e., number of fte’s) can be expected to have a positive correlation with e-procurement because:

- (1) size indicates the supply chain span and scope of activities of an organization; assuming that firms with many employees will have many suppliers, these larger

organizations will benefit more from e-procurement because the number of purchase orders is larger, and the purchase portfolio is larger and more diverse;

- (2) size correlates with the financial resources of an organization; assuming that firms with many employees will have larger turnover and budgets for IT investments, these larger organizations are less restricted in spending budgets on new technologies like e-procurement;
- (3) size indicates the internal span and scope of activities of an organization; assuming that firms with many employees will have many departments, business units, or establishments in which procurements are executed, these larger organizations will benefit more from e-procurement because the need for internal coordination and management control is larger.

An opposite argumentation might also be applicable if one would argue along the option of outsourcing. Assuming that firms with many employees will have an accumulation of scale, scope, and resources as provided by the arguments above, these large organizations will especially benefit from outsourcing their purchase, IT, or both. This would imply that, (very) large organizations are less likely to have adopted e-procurement because they are more likely to have outsourced it.

In addition, industry (i.e. the array of 9 NACE-coded business activities in this case) can be expected to have a distinctive relation with e-procurement because:

- (1) the nature of the supply chain a company deals with and its common position within the value chain differs per industry; organizations that depend on both direct and indirect production goods will generally benefit more from e-procurement than other industries because the number of purchase orders is larger, and the purchase portfolio is larger and more diverse;
- (2) industry is a rough indicator of the need level of information processing and IT use within a company; organizations that primarily process information on a large and frequent basis will gain more advantages from e-procurement than other industries because the IT-enabled integration of purchase processes with other business processes is easier and cheaper;
- (3) industry is an indicator of the network embeddedness of organizations targeting similar markets; organizations that primarily compete with each other on customers, employees, and external funding will benefit more from e-procurement than other industries because the need for cost reduction (in combination with competitive advantages) is larger and more difficult to achieve.

Again, other argumentations might also be applicable. Following DiMaggio and Powell (1983), industry is a context that triggers organizations to follow or copy their competitor’s behavior. Due to competitive, coercive, and

institutional forces, firms experience incentives not to “stay behind,” or follow the “safe choice” of the industries’ majority or best practice (Caldas and Wood, 1999; Benders et al., 2005). This idea of isomorphism, the phenomenon that organizational practices and processes tend to become similar, is specifically found to appear according to industry (cf. Mizruchi and Fein, 1999; Walgenbach and Beck, 2003), although Haveman (1993) found that large organizations look to other large organizations for role models to imitate.

Table 4 summarizes the empirical tests of the relationship between size and industry on the one hand, and the e-procurement variables on the other. For the ease of comparison, share of online purchase and year of first online purchase are recoded into dichotomous variables. This dichotomization can be clearly done on basis of the frequency distribution of both variables (see the previous table).

Table 4 clearly shows that the variation in e-procurement adoption within industries is significantly smaller compared to the variation between industries. The ICT sector is clearly ahead of the other industries as almost 70% say they purchase online. This is probably related to the fact that these companies produce and consult about IT applications as e-procurement as such. One can imagine that ICT firms are intensively organized through IT either

to test, apply, or to demonstrate their own ICT products and services. As one of the manufacturing sectors, the 14 electronics industries reach a relative high level of 52% in e-procurement adoption. The other manufacturing companies however—in transport equipment, chemicals, and particularly in textile and footwear—are below the overall average. The tourism and business service companies have comparable adoption rates, between 40% and 45%. Considering the typical supply chain function of retail one would expect higher levels of e-procurement within this sector. The comparable level of 33% within the health and social services sector can be understood from the notion that IT usage and technological innovation in support activities are low in this sector. Most of these industry differences are similar when we consider the use of e-procurement channels, its share in purchasing, and the history of e-procurement. One of the striking exceptions is that relatively many of the retail organizations (32%) have integrated their systems with the supplier. These firms also use the supplier’s extranet more often. This partly confirms our earlier assumption that procurement is part of the primary activity of retail companies and hence an intensive use of procurement tools and applications can be expected.

The result in Table 4 confirms the expected positive relationship between e-procurement and size. With 46%, the 250+ companies are ahead in purchasing online, but

Table 4  
Proportions of e-procurement adoption and the extent and history of e-procurement by industry and size in a subset of the e-Business W@tch dataset 2003

	Does purchase on-line ( <i>N</i> = 3475)	Uses website supplier ( <i>N</i> = 1511)	Uses e-market-place ( <i>N</i> = 1511)	Uses extranet supplier ( <i>N</i> = 1511)	Integrates systems with supplier ( <i>N</i> = 1511)	Share of purchases online: 5% or more ( <i>N</i> = 1511)	Year of first online purchase: 2000 or earlier ( <i>N</i> = 1511)
<i>Industry</i>							
Textile	29.67	84.48	18.97	25.86	14.66	28.70	35.64
Chem	41.13	85.06	20.69	17.82	17.24	40.24	42.14
Electr	52.48	85.38	28.77	32.08	14.15	50.79	48.90
TransEq	40.83	84.18	22.78	23.42	13.92	31.29	38.62
Retail	36.80	84.68	26.61	34.68	31.45	44.35	50.00
Tourism	43.77	83.54	21.52	28.48	15.19	44.08	52.76
ICT	68.60	88.35	30.52	44.18	22.89	68.86	68.57
BusServ	45.74	88.83	14.89	24.47	11.17	44.07	50.33
Health	33.17	83.33	16.67	21.97	15.15	48.44	39.09
<i>p</i> -Value	.00	.78	.00	.00	.00	.00	.00
$\chi^2$ -test							
<i>Size</i>							
10–49	40.10	86.14	21.89	23.69	15.06	50.00	47.62
50–249	44.54	85.73	22.27	29.47	15.60	43.27	48.35
250+	47.91	84.41	27.38	38.02	25.86	48.10	53.02
<i>p</i> -Value	.00	.81	.18	.00	.00	.06	.40
$\chi^2$ -test							
Total	43.48	85.64	23.03	29.05	17.21	48.88	46.37

Chem: manufacture of chemicals and chemical products (NACE-code 02D– 24,25).

ICT: telecommunications and computer-related services (NACE-code 09I/K– 64.2, 72).

Health: health and social services (NACE-code 10N– 85.11,85.12,85.3).

Textile: manufacture of textiles and textile products, leather and leather products (NACE-code 01D-17,18,19).

Electr: manufacture of electrical machinery and electronics (NACE-code 03D– 30,3 (except 31.3–31.6),32).

TransEq: manufacture of transport equipment (NACE-code 04D–34,35).

BusSer: business services (NACE-code 08K–74).

Touris: tourism (NACE-code 07H/I/O– 55.1,55.2,62.1,63.3,92.33,92.52,92.53).

Retail: retail (NACE-code 06G– 52.11,52.12,52.4).

the size category differences with regard to this basic variable are small. For some of the e-procurement aspects, size differences are more profound, but for others the differences are small and non-significant. Most interesting to see is that 50% of the small firms do more than 5% of their purchases online, while this percentage is even (a little) lower among the larger firms. This indicates that size does determine the probabilities of e-procurement adoption but not the share of e-procurement in the total purchase process.

On the basis of these results one could expect that size and industry also coincide in their determination of e-procurement. To test this, additional multivariate analysis (general linear modeling) is performed to explore the interaction effect between both conditions. The results are against the expectation: on all the e-procurement variables the combination between size and industry is not significant. In conclusion, employee size and industry clearly matter for e-procurement adoption within the seven countries under study, but there are no specific combinations between the two that indicate additional differentiation.

#### 4.2. Do countries differ in e-procurement adoption?

In this section we arrive at the cross-national analysis of the dataset. We first explore if country differences exist at all. The cross-national variation in e-procurement adoption is basically analyzed by comparing the mean scores on all seven indicators, and test for significance on the basis of univariate analysis. Since all seven country subsets are equally proportioned by industry and size (and these firm features are significantly related to e-procurement as we found in the previous section), we assume that the country differences that are found in this dataset are not due to differences in size or industry composition. Of course, in reality, the countries under study *do* differ with regard to size and industry composition of their companies, as we addressed by presenting weighted and unweighted results in Table 3. Because we primarily explore the *relative* differences between countries in this section however, we

do not involve this aspect of weighting in our analysis. Table 5 presents the basic results.

Table 5 shows that countries *do* systematically differ with respect to all indicators of e-procurement adoption. If we first focus on the basic question if companies purchase online or not, it is clear that the variation within the seven country datasets is significantly smaller compared to the variation between these subsets. Germany and the UK are the two “frontrunners” with regard to online purchasing (60% and 67%). Estonia, France, Italy, and Spain are “followers” in this respect (32–42%), including Poland, which holds the lowest proportion in e-procurement (26%). This result might confirm that Poland as a former Eastern European country stays behind the other Western European countries, but Estonia confirms the growth potential of the new entrant countries, in particular with respect to the development and application of ICT and Internet (cf. Carayanni and Popescu, 2005).

When considering the group of e-procurement adopters, country differences are still significant but the rank order becomes somewhat different. German companies are not leading the usage of suppliers’ websites and extranets, nor are they upfront in integrating their systems with suppliers’ systems. British companies that adopted e-procurement are even below average in using e-marketplaces, supplier’s extranets, and supplier system integration. Instead, Estonia and Spain have relatively high proportions on these variables. With respect to the share of e-procurement in purchasing, Polish companies score remarkably high because they hold the lowest score on e-procurement adoption as such. The same “controversy” was found in the previous sector with regard the category of small companies. The year of first online purchase finally, actually represent the pace of adoption of the different countries. To illustrate how the e-procurement adoption rates in the first column of Table 5 are the result of a diffusion process over time, we show diffusion curves by country, plotting the cumulative proportion of first time e-procurement adoption from 1994 until 2003.

Fig. 1 demonstrates that country differences in e-procurement adoption emerged from 1997 on. During

Table 5

Proportions of e-procurement adoption and the extent and history of e-procurement by country in a subset of the e-Business W@tch dataset 2003

	Does purchase online ( <i>N</i> = 3475)	Uses website supplier ( <i>N</i> = 1511)	Uses e-marketplace ( <i>N</i> = 1511)	Uses extranet supplier ( <i>N</i> = 1511)	Integrates systems with supplier ( <i>N</i> = 1511)	Share of purchases online is 5% or more ( <i>N</i> = 1511)	Year of first on-line purchase is 2000 or earlier ( <i>N</i> = 1511)
Estonia	42.07	89.47	11.40	41.23	34.21	42.99	45.10
Poland	25.78	87.07	23.28	29.31	12.07	51.96	53.26
France	39.26	80.30	20.20	32.51	18.23	39.70	36.22
Germany	67.28	83.97	32.07	33.15	13.59	52.71	49.71
Italy	34.92	85.85	21.46	27.32	17.07	38.62	53.48
Spain	32.47	77.54	28.34	34.76	24.06	48.19	45.71
UK	60.34	93.71	16.35	15.41	12.58	46.53	56.64
<i>p</i> -Value	.00	.00	.00	.00	.00	.01	.00
$\chi^2$ -test							
Total	43.48	85.64	23.03	29.05	17.21	46.37	48.88

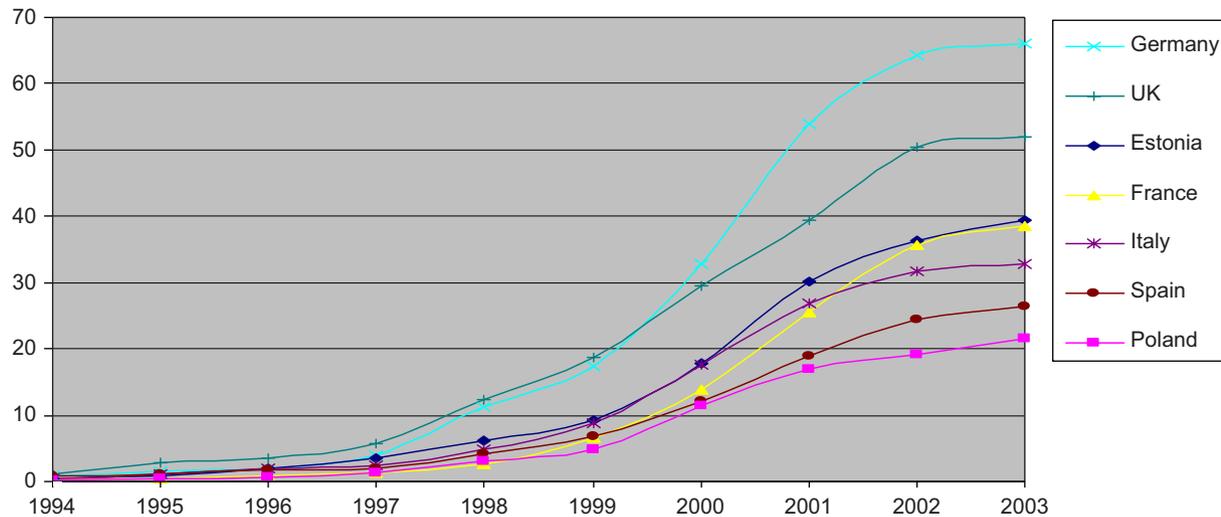


Fig. 1. Cumulative proportions of first time e-procurement adoption by country and year in a subset of the e-Business W@tch dataset 2003.

the period before 2000, there is a clear gap between Germany and UK on the one hand and the other five countries on the other. The country differences further increased after 2000, but in 2003 the relative countries differences are more equally divided compared to the years before. As of 2003, the proportion of German and British companies that purchase online seems to reach their point of saturation, while countries as Estonia, France, Spain, and Poland are still in a growing mode.

Before interpreting the country differences in more detail, we checked the stability of these results by replicating the univariate analysis for each of the nine industry categories and each of the three size categories separately. This enables us to find out whether our results depend on the industry differences. In Table 6 we present the results of these analyses.

The cross-national differences we found earlier are only consistently significant with respect to the initial e-procurement adoption variable. The order of the country differences (Germany and UK are upfront, Poland closes the ranking) also remained stable. In many of the split industry analyses however, the indicators for the extent, scope, and history of e-procurement fail to show significant country differences. The business services appear to be the only sector where country differences are significant for all the e-procurement variables. In contrast, significant cross-national differences are absent when e-procurement variations within electronics manufacturing are separately analyzed. The other sectors show mixed results with regard to country differences in relation to the e-procurement variables. Separate analyses for the three size categories do confirm the significance of most of the cross-national differences in e-procurement.

These results imply that the initial distinction between purchasing online or not, is most relevant for cross-national comparison. Variation within the group of adopters with respect to e-procurement is related to

country differences, but this is not systematically the case for all industries and hence not always relevant. To determine where such country differences come from, we now consider the e-procurement adoption variable as our dependent variable.

#### 4.3. Do countries differ in e-procurement adoption?

The two hypotheses we formulated in an earlier section of this paper are finally tested on the level of countries. Obviously, this means that the number of observations is very limited because we only have seven countries to relate cultural values and e-procurement adoption rates to each other. Instead of the standard statistical measures we present two-dimensional scatterplots. These pictures provide us with the opportunity to actually identify how the data points (i.e. the particular countries involved) contribute to the expected relationship.

If we accept “visual inspection” as a bold method to explore the validity of our hypotheses, both scatterplots appear to support the expected relationship between e-procurement adoption and cultural values at the country level. With regard to Hofstede’s cultural value uncertainty avoidance (left picture) we see clear negative effect: high uncertainty avoidance goes with low levels of online purchasing. Poland, Spain, Italy, and France seem to form one cluster of (relatively) high uncertainty avoidance combined with (relatively) low e-procurement adoption, while Germany and the UK—distinct in their high level of e-procurement—have (relatively) low scores on uncertainty avoidance. A similar expectation was formulated with regard to Au’s cultural item “change is good,” as support for this value is expected to be positively related with e-procurement adoption. The right part of Fig. 2 shows that the position of most countries supports the hypothesis, except for Poland and (to a lesser extent) Italy. The obvious reason behind this lies in the fact that Poland and

Table 6

$p$ -Values of  $\chi^2$ -tests of country differences in e-procurement adoption and the extent and history of e-procurement by size and industry categories in a subset of the e-Business W@tch dataset 2003

	Does purchase online ( $N = 3475$ )	Uses website supplier ( $N = 1511$ )	Uses e-market- place ( $N = 1511$ )	Uses extranet supplier ( $N = 1511$ )	Integrates systems with supplier ( $N = 1511$ )	Share of purchases online is 5% or more ( $N = 1511$ )	Year of first online purchase is 2000 or earlier ( $N = 1511$ )
<i>Industry</i>							
Textile	.00	.81	.81	.26	.86	.30	.03
Chem	.00	.24	.26	.84	.00	.61	.09
Electr	.00	.22	.22	.19	.22	.07	.10
TransEq	.00	.22	.30	.02	.45	.23	.15
Retail	.00	.24	.14	.07	.99	.87	.62
Tourism	.00	.24	.04	.05	.02	.00	.38
ICT	.00	.07	.07	.01	.16	.31	.01
BusServ	.00	.00	.03	.01	.00	.00	.80
Health	.00	.54	.51	.49	.03	.04	.54
<i>Size</i>							
10–49	.00	.00	.02	.00	.01	.18	.18
50–249	.00	.04	.01	.00	.00	.05	.06
250+	.00	.01	.11	.47	.01	.63	.02
Total	.00	.00	.00	.00	.00	.01	.00

Chem: manufacture of chemicals and chemical products (NACE-code 02D– 24,25).

ICT: telecommunications and computer-related services (NACE-code 09I/K– 64.2, 72).

Health: health and social services (NACE-code 10N– 85.11,85.12,85.3).

Textile: manufacture of textiles and textile products, leather and leather products (NACE-code 01D-17,18,19).

Electr: manufacture of electrical machinery and electronics (NACE-code 03D– 30,3 (except 31.3 -31.6),32).

TransEq: manufacture of transport equipment (NACE-code 04D–34,35).

BusSer: business services (NACE-code 08K–74).

Touris: tourism (NACE-code 07H/I/O– 55.1,55.2,62.1,63.3,92.33,92.52,92.53).

Retail: retail (NACE-code 06G– 52.11,52.12,52.4).

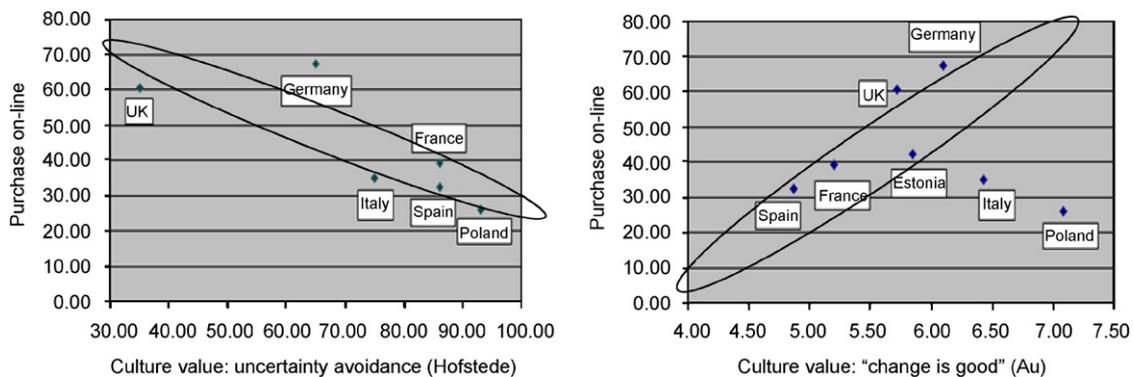


Fig. 2. E-procurement adoption and cultural value by country (sources: means from a subset of the e-Business W@tch dataset 2003; Hofstede, 2002; Au, 1999).

Italy appear to have a (relative) positive orientation toward change but also a (relative) positive attitude toward uncertainty avoidance. It would imply a further comparison between Au's and Hofstede's typology to investigate this seeming discrepancy which is beyond the scope of this paper.

## 5. Summary and conclusion

In this paper we investigated the relevance of national characteristics for the adoption of e-procurement, in our case operationalized as the application of online purchasing. Given that both procurement and IT adoption are

rarely studied in international comparisons, combining these two fields implies that not much theory and data is available to build upon yet. We used secondary survey data from the EU-sponsored e-Business W@tch project in this empirical study. The resulting dataset contains nearly 3500 companies from seven European countries, stratified over nearly all main industries and size categories, and provides information about e-procurement actions collected in 2003.

Summarizing the main results, we conclude that European countries differ in their rate and pace of e-procurement adoption. Over 60% of the respondents from German and British firms say they use online purchasing compared to about 40% of the other (Estonian,

Polish, French, Italian, and Spanish) organizations. These cross-national differences are stable when controlling for employee size and industry. Both are important co-determinants of online purchasing, as we found that larger organizations adopt and use e-procurement much more, and so do the firms within the ICT industry and electronics manufacturing. Cross-national differences are primarily an issue with regard to the basic usage or adoption of e-procurement as such. National variations are less clear if the level of e-procurement among the adopters is concerned. The use of different channels (suppliers' websites, extranets, information systems, e-marketplaces), the estimated share and the year of adoption, are relevant variables for further description of online purchasing but could not be clearly combined into a single measure. In search of a further explanation of the international variations we found, it can be shown that e-procurement adoption is lower in countries with high uncertainty avoidance and higher when the national attitude toward change is favorable. This latter result especially should be interpreted with care as it is based on the comparison of averages from seven countries only.

The results in this paper can be considered as explorative and are open to further elaboration and improvement. One way to do that would be by specifying the economic and technological conditions for e-procurement, which would lead to insight in more detail into the reasons why differences at the country level have such a strong influence on what seem to be strictly economic decisions.

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