Adoption of communication technologies and national culture

Gert Jan HOFSTEDE

Senior Researcher, Mansholt School for the Social Sciences,
Wageningen, The Netherlands

RÉSUMÉ

Les pays du monde n'adoptent pas les nouvelles technologies de communication à la même vitesse. Cet article se pose la question quelles variables, autres que le produit national brut par personne, pourraient élucider ce phénomène. Se basant sur des données empiriques au niveau national, il conclut que des variables culturelles sont en jeu. En particulier, les dimensions culturelles de l'individualisme et du contrôle de l'incertitude prédisent la nature et la rapidité d'adoption des technologies.

Les différences culturelles entre pays vont-elles disparaître suite à la venue du « village global » ? Ce papier propose que bien au contraire, les nouveaux média de communication permettent aux gens de renforcer leurs identités culturelles.

Mots-clés : Technologies de communication, Culture nationale, PNB par tête.

ABSTRACT

This paper investigates the question what attributes of countries influence the differential speed at which they adopt new communication technologies. On the basis of empirical data, it concludes that besides GNP per capita, cultural variables predict the speed of technology adoption. In particular, the cultural dimensions of individualism/collectivism and uncertainty avoidance can be used to predict the ease and speed of changes. Cultures of strong uncertainty avoidance are slow in adopting any new technology

The paper also argues that, contrary to popular belief, the advent of the global village does not lead to the disappearance or even to the lessening of cultural differences between countries. On the contrary, new communication media enable people to strengthen their cultural identities.

Key-words: Communication technology, National culture, GNP per capita.

1. INTRODUCTION

Does the information age reduce the distances between countries? Certainly, mass media have brought events that happen all over the world to the attention of billions of people. Likewise, communication technologies enable fast communication between people wherever they are on the globe. But does this also imply that we shall soon all be living in a global village with one shared global culture? Popular wisdom among predominantly North American businesspeople has been that differences between at least the developed countries are diminishing. This belief is apparent in studies of globalization that do not use national culture as a relevant variable. For instance, King and Sethi (1998), in an empirical study of transnational information systems, address the business environment of a firm, its structure and management processes, and its information systems configurations, without considering cultural differences between the countries in which a transnational firm operates. They refer to differences between countries only once, when they define the concept of market integration (p. 209): "Market integration refers to the extent to which the parent corporation views the international market as a single competitive arena. (...) The importance of this characteristic is emphasized by Bartlett and Goshal (1989), who note that a company cannot manage globally if its managers identify with local, parochial interests and objectives." Although this does not necessarily invalidate their findings, it does indicate an implicit belief that national culture is not an important variable. And it begs the question whether local interests are by definition parochial. It certainly seems congruent with the picture that Castells (1996) draws of international business. This could be described as the U.S. market economy model extended to a global scale: hard, flexible and opportunistic global capitalism. Could this be nicknamed 'Global U.S. parochialism'? Some might say yes, see e.g. Blunt and Jones (1997).

The specific focus of this article is the diffusion of new communication technologies. For the empirical part, we shall look at this phenomenon from a very high aggregation level: that of nations. The central question is whether there is more than just GNP per capita that determines the spread of communication technologies, and if so, what is it? A corrolary question is whether new communication technologies are in fact cultural homogenizers or not.

2. RELATED RESEARCH

2.1. Diffusion of Technology

Research on the diffusion of new communication technologies abounds in the literature. Various perspectives are taken. Much U.S. research takes place at the level of individuals. Jane Webster (1998), for instance, uses the perspectives of communication media choice, systems analysis and design, and privacy to investigate the use of desktop videoconferencing in a North American hightech organization. Karahanna et al. (1999) report about a study about the adoption of Windows

3.1 in a large financial institution in the U.S. Midwest. They use the theory of reasoned action and aspects of innovation diffusion theory, two theories of personal attitude and intention.

Both studies are well presented pieces of research, but it is very hard to tell whether the results could be extrapolated to other contexts, particularly outside the United States. Smith and Bond (1993) show that most psychological research does not replicate well across countries. They successfully use the concept of national culture to account for many of the differences. Robey (1995) has argued that theories from the social sciences can often explain seemingly contradictory impacts of information technology.

2.2. National culture

The concept of national culture has rapidly become widely applied in the IS discipline since the rise of the network era. In this article, we adopt the definitions given by Hofstede (1980, 1991, 2001). He defines culture as "the collective programming of the mind that distinguishes the members of one group of people from those of another". "Collective programming of the mind" is what most people would call education or socialization, i.e. it occurs from early infancy on.

Hofstede distinguishes five dimensions of national culture:

- Individualism versus collectivism. This is the degree to which people derive their identity primarily from being an individual versus being a member of social groups.
- Power distance. This is the degree to which differences in power, status and privileges are accepted in society, and considered a 'natural order'.
- Masculinity or achievement orientation versus femininity or cooperation orientation. This distinction could be relabeled "big and fast are beautiful" versus "small and slow are beautiful". It is related to gender roles.
- Uncertainty avoidance. This is the degree to which novel phenomena or ambiguity are perceived as threats.
- Confucian dynamism. This dimension, also labeled short-term versus long-term orientation, has to do with balancing the virtues of tradition and the present against those of the future.

For the sake of brevity, these dimensions shall not be elaborated in more detail here. Typically, Anglo-Saxon countries are characterized by very high individualism, small power distance, strong masculinity, weak uncertainty avoidance and short time orientation. Other countries have widely varying combinations of scores.

2.3. Convergence or divergence?

Studies that consider national culture as a potential determinant of technological change have not found that the world's cultures are converging. Craig et al. (1992) carried out a longitudinal analysis across 18 countries, including 16 European countries, the U.S. and Japan. They pitted data for a number

of indicators of economic development against Hofstede's national culture dimension scores, much in the way in which it is done in the present paper, but using data for 1960, 1970, 1980 and 1988, thus creating an image across time. Using multidimensional scaling, they found several dimensions of change. The most important of these was "standard of living", associated among other things with the possession of consumer goods such as telephones and radios, which increased most in individualist countries. The second most important was "cost of living", which increased most in collectivist, large-power-distance countries. They concluded that, contrary to their expectations, countries were not converging but diverging during the period 1960-1988, and that the divergence could be culturally explained through differences in the cultural dimension of individualism versus collectivism.

Inglehart and many others, in the World Values Survey programme (2000), have also found that national value systems are resilient to changes. The World Value survey programme has run since 1981. It includes 65 societies containing 75% of the world's population. Using data from three waves of the World Values Surveys, they found evidence of massive cultural change *and* the persistence of distinctive cultural traditions across countries. Values of younger age cohorts are shifting towards postmodernization, characterized by a declining role of authority and a stress on personal well being. In the parlance of Hofstede's dimensions, this would be called smaller power distance and higher individualism. Inglehart and Baker (2000) found that cultural change is path dependent. They say that for the duration of their research programme (1981-2000), the broad cultural heritage of a society – Protestant, Roman Catholic, Orthodox, Confucian, or communist – leaves an imprint on values that endures despite modernization.

2.4. Diffusion of technology across countries

For those innovations that take place in an international context, it is obvious that national culture might be one of the independent variables. Many authors use the concept and find it relevant. For instance, on the basis of empirical investigations, Garfield & Watson (1998) caution countries to align their national information infrastructure with their national culture. Likewise, experienced authors state that working in the information age requires cross cultural competency (Keen 1991, O'Hara Devereaux and Johansen 1994). Yet, the concept of national culture is not always articulated much in the U.S. literature in the field of Information Systems. Let us consider the series "International Perspective" in the Communications of the ACM. A.K. Danowitz et al. (1995) discuss the slow spread of information technology across North Africa. They do touch upon the issue of culture (p. 28): "the computer evolved overwhelmingly in the west in a manner compatible with western mentality, language, cultural and political values. When IT is injected into cultures such as those of North Africa, it comes loaded with an

embedded virtual value system. There may be conflicts of social, political, and economic dimensions that have to be resolved for widespread assimilation to take place." Similar statements have been made about other technologies by other authors (see e.g. Goulet 1977, Jaeger & Kanungo 1990).

J.L. Dedrick et al (1995) discuss the spread of information technologies in very small countries. They define a very small country as a country with fewer than 10 million inhabitants. Their sample includes the Scandinavian countries, Hong Kong, Ireland, Israel, New Zealand, and Singapore. In fact these are all the richest "very small countries" in the world, except Switzerland and Austria. This would indicate that these two countries are the outliers, not the nine in the authors' sample! The authors conclude that English as a professional language is important. They also raise the issue of government control over information sources such as the Internet and ask the question whether in countries that are used to some government censorship "political and social cultures will have to change to deal with the potential flood of uncontrolled information."

In these two papers, the relevance of national culture to the diffusion of information technology is mentioned. But it seems that the non-western national cultures, not the technologies, are seen as problematic. But whereas the technologies change rapidly, the cultures do not – so, defined in this manner, the problem might not disappear.

2.5. Group Support Systems

Group Support Systems (GSS) will be used here as an example of a novel PC-based communication technology. They originate from an Anglo context, and their assumed benefits reflect Anglo cultural values: individual contributions, equality in participation, reduction of pressure to conform, task orientation, objectivity. El-Shinnawy and Vinze (1997) carried out experiments with U.S. (individualistic, small power distance) and Singaporese (collectivist, large power distance) MBA students. Groups used face-to-face discussion or GSS to discuss a current topic. The authors expected the U.S. students would perform similarly in the two conditions. However, it turned out that they contributed much less in the GSS condition. The authors attributed this to the fact that their personal contribution was not salient in the GSS condition, making it less profitable for them to contribute. They expected the Singaporeans to be much affected by the GSS, because it would enable them to contribute anonymously rather than having to conform to the leader's point of view. Against their hypothesis, the Singaporeans behaved similarly under the two experimental conditions. The authors explain this as follows: "Anonymity, however, is counter productive to the fundamental mechanism by which groups in collectivist, large-power distance communities operate. (...) Rather than changing their behavior, GSS as a medium of communication provides them with a medium to continue behaving in the same manner as they would in a face-to-face setting."

The authors do not state what seems apparent from their findings, namely, that anonymity is also counter productive to the fundamental mechanism operating in the U.S. teams. This mechanism may be caused not only by the individualism and small power distance in the U.S. culture, but also by its strong masculinity. Observers from countries low on masculinity have stated that U.S. people use meetings to "show how good they were", and that is, in the cultural sense, a masculine value: one cannot show off when one is anonymous.

Despite the Anglo origins of GSS, De Vreede et al. (1998) report about unexpected successes with them in East Africa. A possible explanation is that using the GSS was a gratifying, status-enhancing new experience for all participants, perhaps also enhanced by the presence of the researcher. It can be inferred that taking a technology out of its cultural context of origin need not invalidate it, but one should be aware that it might take on a different meaning in the new context.

Information technology other than GSS also supports groups. Zhang and Hao (1999) examined how ethnic Chinese in the U.S. use the Internet to fortify their own cultural identity while functioning within mainstream U.S. culture. The use of the Internet or mobile phones for diverse networks of specialist, extremist or otherwise deviant groups, such as researchers, hooligans or criminals, is another case in point. Such networks are not necessarily endowed with a subculture of their own, but they might well be. Making it possible to communicate with those who are similar, to the neglect of those who are near, is a powerful attribute of communication technology. Lievrouw (1998) uses the label "heterotopic communication" for a form of such communication. "These personal and technological devices allow individuals (...) to avoid exposure to disagreement, difference, or other information that does not serve their direct purposes or reflect their particular views of the world (...)." Her definition is linked with individualistic, masculine culture traits. In fact, she shows how the new technologies enable U.S citizens to act out their national culture more effectively than before.

2.6. Summing up

A preliminary conclusion to be drawn from this review of various researches is that

- at the level of nations, the increase in communication across the world has so far not led to a reduction of differences between countries. Cross-national differences in cultural value systems are a meaningful device to explain the persistent differences;
- at the level of individuals or groups, people maintain cross-cultural differences by shaping their use of communication technologies to suit their cultural values.

3. DATA

The data on national culture that we used as independent data were taken from Hofstede (1980, 1991). The five dimensions are computed as indices

running from approximately zero to one hundred:

- PD, power distance index;
- IND, individualism index;
- MAS, masculinity or achievement orientation index;
- UA, uncertainty avoidance index;
- LTO, long term orientation index.

Although these data were collected in the 70's, subsequent research has repeatedly established their continued validity (Hofstede, 2001). According to Hofstede, countries that become richer also become more individualistic over time, and power distances tend to diminish. The other dimensions do not vary over time with national income. Smith and Bond (1993) review a number of multicultural studies of values and suggest on that basis that values are free to vary in a number of ways independent of the country's level of modernization. Hofstede himself (2001) demonstrates that, while national cultures certainly can vary with time, differences in cultures across countries are very long-lived.

The countries in this research are those that were included in Hofstede's data (1980). They were countries in which the IBM Company had offices in the early 70's. These are more or less the same countries that nowadays have a sizable deployment of new communication technologies.

To measure the diffusion of new communication media, the World Development Indicators published by the World Bank (1999, 2000, 2001) were used. Of these, the following demographic data were selected as independent control variables:

- GNP per capita 1997 in US $. We expected this to be a very important determinant.
- Population density in people/square km 1997.
- Total population as of 1997.

We did not expect the latter two to be of importance, but we wanted to check that.

The following indicators of adoption of communication technologies were used as dependent variables:

- Number of copies of daily newspapers per 1,000 people 1996.
- Number of radios per 1,000 people 1996.
- Number of television sets per 1,000 people 1997.
- Number of personal computers per 1,000 people 1997.
- Number of fax machines per 1,000 people 1996.
- Number of Internet hosts per 10,000 people July 1998.
- Number of mobile phones per 1,000 people 1997.

We shall call the above set of variables the 1997 data set. Figures for the next two years (1998 and 1999 except Internet hosts for which data are more recent by one year, and radios, for which data are of 1997 and 1999) have become available for all the demographic and technology variables, except number of newspaper copies. We created a second and third data

matrix from these so that we could compare 1997, 1998 and 1999.

For the statistical part, the 1997 data were split in two different ways:

- The 25 richest countries worldwide. These were the countries with a GNP per capita above $10,000. None of these was missing in Hofstede's set. The richest one among these is Switzerland, with $43,000, while the poorest is South Korea with $10,550. These countries are the European countries Austria, Belgium, Denmark, Finland, France, Germany, Greece, republic of Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom, plus Australia, Canada, Hong Kong, Israel, Japan, South Korea, New Zealand, Singapore, and the United States.
- The countries that were in Hofstede's original sample. These were the 25 richest plus Argentina, Brazil, Chile, China, Columbia, Costa Rica, Ecuador, Egypt, El Salvador, Guatemala, India, Indonesia, Iran, Jamaica, Malaysia, Mexico, Nigeria, Pakistan, Panama, Peru, Philippines, South Africa, Thailand, Turkey, Uruguay, Venezuela, Zimbabwe. The poorest of these is Nigeria, with GNP per capita = $ 280. For the African countries in this set, the culture data indicate North, East and West Africa, but these are not categories in the World Bank data. Egypt, Zimbabwe and Nigeria were therefore chosen as representative countries consistent with the original IBM sample data. Croatia, Serbia and Slovenia now represent former Yugoslavia. Russia has been added using culture score estimates created by Geert Hofstede. This makes a total of 56 countries.

The reason for using two data sets is that we expected the role of GNP per capita to be very dominant in the worldwide data set. In the sample of rich countries, the supposed influence of GNP per capita on the data matrix is much smaller than it is worldwide. This would enable us to see what predictive power, if any, the culture scores would retain among countries of roughly comparable wealth.

4. RESEARCH QUESTIONS

Our main research question was: Do any of the scores on Hofstede's five dimensions of national culture explain variance in differential penetration of communication media? To operationalize this question, we created a number of hypotheses. It should be noted that our data do not allow us to make any inferences as to the use that people make of the communication technologies. As far as the data go, the use of a PC might vary from idly sitting on a desk as a status symbol to being vital for its user as a means of communicating daily with colleagues worldwide.

We expected GNP per capita to be the main predictor in the worldwide data set, and we expected it to be correlated with high individualism and small power distance, as the literature indicates (Inglehart et al. 2000, Hofstede 2001). Therefore:

Hypothesis 1: Individualism and small power distance are significantly associated with the penetration of all

communication technologies. This relation is moderated by GNP per capita.

The question now becomes: what if we correct for the influence of GNP per capita? The remaining hypotheses convey our predictions after correcting for the influence of GNP per capita.

We expected that individualism would still correlate with penetration of communication technologies, in the same way that private time and space are associated with individualism: as part of people's identity (Hofstede, 2001). Likewise, we expected small power distance to be still correlated to communication technology penetration because in a society of small power distance all citizens would wish to purchase the technologies while in a society of large power distance their possession and use might be limited to specific strata. Therefore:

Hypothesis 2: When corrected for GNP per capita, individualism and small power distance will still be predictors of penetration of communication technologies.

We expected the other dimensions of national culture to play a less dominant role. As far as uncertainty avoidance was concerned, we expected that novelties would take longer to penetrate in societies of stronger uncertainty avoidance, as De Mooij (2001) found in her longitudinal study about the penetration of various consumer goods among European countries since 1960. She found that penetration of new products correlated with weak uncertainty avoidance, but that this correlation was lost or inverted after a number of years when the product had become generally established. Therefore:

Hypothesis 3: Uncertainty avoidance will correlate negatively with the spread of new technologies: PC, Internet, mobile phones. This correlation decreases over the period of investigation.

We expected that there might be some correlation between masculinity and status-providing technologies. De Mooij (2001) reports such a correlation for ownership of multiple cars. She also observes that this effect is not clearly observable at macro level (number of cars per thousand people). It becomes manifest when you look at second and third cars. In the present study such data are not available for the communication technologies. We consequently expect a negligible correlation. Therefore:

Hypothesis 4: Masculinity will not correlate significantly with the spread of communication technologies.

Finally, we expected short term orientation to be correlated with a preference for immediacy of communication. The slower, asynchronous media (newspapers, paper mail and perhaps faxes) would thus be correlated with long-term orientation. We have no data about paper mail. Therefore:

Hypothesis 5: Long-term orientation will correlate significantly with the spread of newspapers.

5. EMPIRICAL RESULTS

5.1. Worldwide data set

Pearson correlation coefficients were computed between all the variables in the 1997 data set. There was an abundance of high correlations. The three

years showed a remarkably stable pattern despite huge increases in numbers of new technologies. To illustrate this, here are some correlations among the independent variables (table 1). GNP/cap correlated with culture dimensions for the 52 country sample: with IDV = .68***, with PD = -.59***, with UA -.25*

	1997	1998	1999
IDV	.68***	.70***	.73***
PD	-.59***	-.63***	-.65***
UA	-.25*	-.27*	-.27*

Table 1: Correlations of GNP/cap with culture dimensions for the 56 country sample (only significant correlations are shown; * = p < 0.05, *** = p < 0.005).

Because of these high correlations between independent variables, we ran a number of exploratory factor analyses on the worldwide data set. Gorsuch recommends factoring the independent and dependent variables both separately and together to get to know the pattern of variance (Gorsuch, 1983, chapter 17). Factoring the dependent variables without the predictors (the independent variables: demographics and culture dimension scores) yielded one factor only. Adding the predictors changed the picture to four factors, each loading other dimensions of culture. There are no independent variables scattered across factors, which is desirable. When rotated obliquely, the same factors emerged as with orthogonal rotation, with culture dimension scores aligned with factors and correlations between factors not exceeding 0.2. We therefore proceeded with the orthogonal solution using principal components analysis and rotating with Varimax. Missing values were excluded listwise. There are many missing values for the LTO scores. We therefore also ran a factor analysis without LTO to see whether this would affect the outcome. This had the effect of collapsing the second and third factor but otherwise left the factor matrix very similar. We therefore felt confident to use the version presented in Tables 3 and 4. Table 3 presents the variance explained for the factors with eigen value > 1. Table 4 presents the factor matrix.

Over the three years, communication technology penetration changed considerably. By far the largest relative changes were increases in the numbers of mobiles and Internet hosts (table 2). Yet when the same factor analysis was run on the 1998 and 1999 data sets, the results were strikingly similar.

	1997	1998	1999
Radios	570	596	605
TV sets	349	363	359
PCs	130	149	160
Faxes	19	20	19
Internet hosts	123	165	236
Mobile phones	100	149	223

Table 2: Average numbers per 1,000 inhabitants for the 56 country sample across three years.

Because the factor matrices were so similar, no further statistics were carried out for the 1998 and 1999 data.

Table 4 shows that IDV and PD together form the first and most impor-

tant factor. This factor is loaded by GNP per capita, but the loadings of IDV and PD are higher than that of GNP per capita. We could label it "Western style affluence". For the sake of simplicity the name "Individualism" shall be used for the variable that loads the factor most strongly. All communication technologies, but for the number of newspaper subscriptions, load on it.

The other factors each coincide with one dimension of culture, and can carry the name of that dimension. Long term orientation is by far the most important of these. It loads newspapers and newer communication technologies. Together, the first two factors include the variance of GNP per capita.

From 1997 to 1998 there are very few changes. The most conspicuous of these is that the loadings of PCs and especially of mobiles on the uncertainty avoidance factor show a marked decrease as predicted. From 1998 to 1999 there is a slight shift between factor 3 and 4, with Population loading more on factor 4. The loading of mobile phones on the uncertainty avoidance factor continues to decrease. The differential speed of decrease between mobiles and PCs reflects the fact that mobile phones are becoming common faster than PCs.

In order to be able to correct for the variance caused by the demographic variables, we ran a stepwise regression with probability of F to enter (PIN) =.05 and probability of F to be discarded (POUT) =.1. The result is presented in table 5. Here, the many missing values for LTO were a problem. Including LTO was so detrimental to the significance of the analysis that we decided to leave it out. In the first regression step, only the demographic variables were included. The culture dimension scores were added in the second step only, even if they correlated more strongly with the variable to be explained than did the demographic variables. We did this in order not to mistake a wealth effect for a culture effect.

At first glance, table 5 seems to give overwhelming evidence that national wealth as expressed through GNP per capita is what primarily drives the adoption of new communication media. It has to be noted, though, that GNP per capita is correlated most significantly with individualism and small power distance, and to a lesser degree with weak uncertainty avoidance, and one could argue about the causality of these correlation coefficients. As argued previously, there is evidence that increased affluence leads to shifts in individualism and power distance.

Individualism predicts the number of radios, TV sets and Internet hosts. Power distance has little effect when other effects have been accounted for. Only the number of PCs is negatively associated with it. This could reflect the fact that in large power distance societies, wealth is divided so unequally that few people can afford to buy a PC. However, this effect accounts for only 1% of variance. The regression makes it clear that power distance is not nearly as important a predictor as individualism.

A few other trends can be noticed. Notably, the number of PCs and mobi-

le phones correlates negatively with uncertainty avoidance, as predicted by hypothesis 3. The correlations diminish over time as predicted.

Finally, the dimension of masculinity versus femininity opposes faxes to mobile phones and to Internet hosts. Indeed, faxes are a one-way medium and are therefore a typical medium for issuing commands or orders. Mobile phones, on the other hand, are a typical two-way medium.

But why is the number of Internet hosts negatively correlated with masculinity? This may be because in feminine countries, public services are deemed important, and Internet hosts are being used in these countries as a vehicle for public services (De Mooij, 2001).

5.2. Richest 25 countries data set

For the richest 25 countries, the only dimension of national culture with which GNP/cap correlates significantly is UA at -.38*. This makes the correlation coefficient matrix much easier to interpret than in the worldwide data set. Table 6 presents the correlation matrix. Table 7 presents the results of a regression analysis performed in the same way as the earlier one.

Although the differences in wealth among these 25 countries are still considerable, it turns out that in this sample, the culture dimensions are relatively more important for explaining the differences than they are in the wordwide set.

Overall, the correlations with culture dimensions are similar to those in the wider data set, but relatively stronger. In the regression analysis, though, the correlations with masculinity/femininity do not appear. This can be attributed to the relatively small proportion of Latin countries in this sample. A positive correlation between number of TV sets and power distance crops up in the regression analysis. This could be explained by the hypothesis that in small power distance cultures people might be less inclined to use a medium in which they have historically been forced to be passive listeners. Conversely, inhabitants of countries with large power distance would use radio and TV to see and hear their leaders.

Rotation sums of squared loadings									
Factor	Total			% of variance			Cumulative %		
	1997	1998	1999	1997	1998	1999	1997	1998	1999
1	6.3	6.2	6.9	39.3	39.0	40.5	39.3	39.0	40.5
2	3.6	3.6	3.7	22.7	22.8	21.7	62.1	61.8	62.2
3	2.0	1.9	2.0	12.4	12.1	11.6	74.6	74.0	73.8
4	1.8	1.7	1.9	11.0	10.5	11.0	85.6	84.4	84.9

Table 3: Factor analysis on 56 country sample 1997, 1998 and 1999, total variance explained

Variable	Factor			
	1: Individualism	2: Long term orientation	3: uncertainty tolerance	4: masculinity
Predictors	1997 1998 1999	1997 1998 1999	1997 1998 1999	1997 1998 1999
IDV (Individualism)	**.900**			
PD (power distance)	**-.811**			
MAS (masculinity)				**.876 .883 .817**
UA (uncertainty avoid)			**-.925**	
LTO (long term orient)		**.873**		
Control variables				
Population			-.369 -.461 -.313	**.700** .642 **.754**
GNP per capita	.676 **.736 .776**	.625 .573 .514		
Population density		.615 .630 .562	.635 .629 **.713**	
Dependent variables				
Newspapers		**.898**		
Radios	**.883**			
TV sets	**.888**			
Mobile phones	.469	**.726 .777 .741**	382 .300 .257	
Faxes	.624	.597		.364 .340 .398
PCs	**.801**	336	.440 .392 .390	
Internet hosts	**.873**			

Table 4: Rotated factor matrix for 56 country sample; loadings above .3 are shown, above .7 in boldface. Loadings for 1998 and 1999 are only shown if a shift of more than .04 occurred across 1997-1998 or 1998-1999

	1st step: Demographic variables		2nd step: Culture dimensions	
Medium	GNP/cap or Pop density		3rd predictor	4th/5th predictors
Newspapers	GNP/cap, R^2 = .59	Popdensity, R^2 = .67		
Radios	GNP/cap, R^2 = .59		IDV, R^2 = .69	
TV sets	GNP/cap, R^2 = .67	Popdensity (-), R^2 = .71	IDV, R^2 = .74	
PCs	GNP/cap, R^2 = .84		UA (-), R^2 = .87	MAS (-), R^2 = .90 / PD (-), R^2 = .91
Faxes	GNP/cap, R^2 = .70		MAS, R^2 = .73	
Internet hosts	GNP/cap, R^2 = .42		IDV, R^2 = .50	MAS (-), R^2 = .56
Mobiles	GNP/cap, R^2 = .66		MAS (-), R^2 = .69	UA (-), R^2 = .71

Table 5: multiple regression for 56 countries sample 1997 (PIN = .05, POUT = .1)

Medium	GNP/cap	Pop density	PD	IDV	MAS	UA
Newspapers	.48**	.49**	-.01	-.27	-.07	-.36*
Radios	.32	-.18	-.26	.60***	.07	-.41*
TV sets	.34*	-.40*	-.12	.63***	.16	-.06
PCs	.68***	.14	-.35*	.43*	-.20	-.77***
Faxes	.63***	.06	-.07	.21	.26	-.20
Internet hosts	.32	-.19	-.39*	.47**	-.34	-.39*
Mobile phones	.38*	.28	-.22	-.07	-.37*	-.46*

Table 6: Pearson correlation coefficients for 25 richest countries across the world 1997

	1st step· Demographic variables		2nd step. Cultural dimensions	
Medium	GNP/cap or Pop density		3rd predictor	4th predictor
Newspapers	Pop dens, R^2 = .25	GNP/cap, R^2 = .42	-	
Radios	-	-	IDV, R^2 = 36	
TV sets	Pop dens (-), R^2 = 16	GNP/cap, R^2 = 32	IDV, R^2 = .46	PD, R^2 = 56
PCs	GNP/cap, R^2 = .47		UA (-), R^2 = .77	
Faxes	GNP/cap, R^2 = .40		-	
Internet hosts	-		IDV, R^2 = .22	
Mobiles	-		UA (-), R^2 = 21	

Table 7: Multiple regression for 25 richest countries across the world 1997 (PIN = .05, POUT = .1)

6. HYPOTHESES REVISITED

Hypothesis 1: Individualism and small power distance are significantly associated with the penetration of all communication technologies. This relation is moderated by GNP per capita.

Hypothesis 1 is very strongly supported by all the analyses for all technologies with the exception of newspaper subscriptions. The factor analysis suggests that the central driving force behind the adoption of technologies is a combination of individualism and to a lesser extent small power distance. These dimensions load much stronger on the factor than does GNP/capita. This value combination, it can be inferred from prior research, is itself a consequence of increasing affluence in countries with certain existing value systems. The growing loading of GNP/cap over the three years may reflect increasing wealth in the countries with high individualism and small power distance, resulting in increasing correlations between GNP/cap, individualism and small power distance, as is apparent from table 1.

Hypothesis 2: When corrected for GNP per capita, individualism and small power distance will still be predictors of penetration of communication technologies.

Hypothesis 2 receives partial support from the factor analysis, as argued above. It receives additional support from the 25 richest country data set. For Radios, TV sets and Internet hosts, Individualism is the prime variable that explains their proliferation in the multiple regression. Small power distance is never a determinant. On the contrary, large power distance helps explain the spread of TV sets.

Hypothesis 3: Uncertainty avoidance will correlate negatively with the spread of new technologies: PC, Internet, mobile phones. This correlation decreases over the period of investigation.

Hypothesis 3 is confirmed by all analyses for PCs and mobile phones, both for the negative correlation and for the decrease over time. The trend is not clear for Internet hosts. There are negative correlations, but they do not appear in the factor analysis or regressions. It could be that Internet hosts are not so much the domain of private persons as PCs and mobile phones, and therefore less sensitive to resistance to change.

Hypothesis 4: Masculinity will not correlate significantly with the spread of communication technologies.

Hypothesis 4 is falsified, though not very strongly, by several correlations. First, there are correlations of femininity with mobile phones, PCs and Internet hosts in the regression analysis in table 5. Then, femininity correlates significantly with mobile phone proliferation in the rich country data set (table 6). Masculinity correlates with faxes in the regression analysis of the worldwide data set (table 5).

Hypothesis 5: Long-term orientation will correlate significantly with the spread of newspapers.

Hypothesis 5 is not falsified. In the factor analysis, the long term orientation factor loads newspapers and mobile phones stronger than the individualism factor, faxes about as strongly, and PCs to a lesser degree. In the regression analyses, we did not include long-term orientation, so there is no telling whether it would have cropped up. Based on the very high loading it seems likely that long-term orientation does predict number of newspapers. As far as the other loadings go (for mobiles, faxes and PCs), long term orientation could be a predictor in the same way as individualism/small power distance, i.e. through GNP per capita as a moderating factor. The influence of the Asian economies is manifest here.

7. DISCUSSION

7.1. Effect of national culture along dimensions

The spread of communication technologies naturally is dependent on the wealth of a country. If one corrects for the effect of GNP per capita, clear effects of culture remain.

Power distance is not strongly correlated with the spread of communication technologies. There are slight correlations, but they can largely be accounted for by the effect of GNP per capita. In regression analysis, they are neither prominent nor consistent across the three samples. Possible effects of power distance on the distribution of communication technology devices among the population do not appear in this research, but can be assumed.

High individualism is strongly correlated with the spread of those communication technologies that enable people to isolate themselves: radio, TV, Internet hosts. This correlation is manifest in the first factor from the factor analysis, which could be termed "standard of living". It can be considered to be in line with the findings of Craig et al. (1992), who found that standard of living measured in the possession of consumer goods increased most in individualist cultures. The cor-

relation with the number of PCs is less marked, but likely to rise as PCs become more widely accepted in uncertainty avoiding countries.

Uncertainty avoidance correlates negatively with the spread of the newer technologies: PCs and mobiles, notably. This correlation will disappear over the years, but will be transferred to the new technologies of the future. The trend from 1997 to 1999 shows that the correlation was on its way down during that period.

Worldwide, masculinity correlates positively with the spread of devices for one-way communication (faxes) and negatively with that of devices for two-way communication (mobile phones). There is a less prominent negative correlation with PCs and Internet hosts. These correlations are not found so strongly in the 25 country data set. They are likely to become more pronounced as the technologies involved lose their novelty.

7.2. How are the technologies used?

The figures show a relationship between the numbers of devices across countries. They do not show us how the technology is being used. Fortunately, others have investigated this. Here are two examples that show how dimensions of culture could play a role.

Ang & Nadarajan (1996) describe how the Singaporean government uses the Internet to maintain the type of censorship that is customary in that country. In their words: "One way to control technology is to use technology itself as a control mechanism, and the Singaporean government has looked into using technology in censorship." Singapore is characterized by large power distance, strong masculinity and collectivism. This value orientation can account for the high level of control that the government wishes to maintain over its citizens and the forceful methods it employs to do so. At the same time the country is very low on uncertainty avoidance, and this can explain why it is so fast in turning a novel communication technology to its advantage.

De Mooij (2000, 2001), a researcher in international marketing, processed questionnaire responses from 15 European countries about internet use for various purposes. In a multiple regression analysis, De Mooij empirically found that "almost daily use" of the Internet:

- for business purposes can be predicted by small power distance;
- for education/science can be predicted by femininity;
- for e-mail can be predicted by uncertainty tolerance;
- for leisure/personal reasons can be predicted by both femininity and uncertainty tolerance.

Apparently, the significance of the Internet is culture-dependent. In cultures with large power distance, it is not used for business, because it does not fit with steep hierarchy or centralized control, at least not in its present form. The correlation of use for education and leisure with femininity may be attributed to the fact that femininity is associated with a focus on the quality of life, rather than achievement. The correlations with weak uncertainty avoi-

dance will disappear over time, and shift to newer technology platforms.

7.3. Further research

This study is based upon only three years' data. Therefore, many of the findings are hard to interpret. It will be particularly interesting to replicate the study in a few years' time to see in what direction trends are developing. In all probability, current categories of communication technologies will have merged by then. New technologies will take their place.

8. CONCLUSION

This paper has empirically demonstrated that new communication technologies do not spread equally rapidly across countries, and that this cannot be attributed to differences in wealth only. National culture plays a prominent role.

When a new communication technology is introduced, the dimension of national culture that predicts its speed of adoption is uncertainty avoidance: the higher a country scores on this dimension, the slower will it be in adopting a new technology. However, in the course of a number of years, this effect wears off. Mobile phones and PCs show this trend over the study period, 1997-1999.

Other dimensions explain the eventual level of penetration of the communication technologies. By far the most important of these is individualism/collectivism. Power distance plays a lesser role. Wealth, individualism and small power distance are strongly correlated, but high individualism predicts penetration of established communication technologies (radio and TV) and Internet hosts even after correcting for GNP/cap.

The masculinity/femininity dimension affects the differential penetration of one-way versus two-way communication media (fax versus mobile), the latter being more popular in feminine countries.

The empirical part of the research did not include data about usage patterns. The same communication technology can be used for different purposes across countries. Other research suggests that if the technology in question is adopted, it is used in ways that are compatible with the local culture. Far from being a cultural homogenizer, communication technology enables expression of cultural uniqueness. In other words, people use the technology to express their existing cultural values in new ways.

9. ACKNOWLEDGEMENTS

The author is grateful to Geert Hofstede and to Marieke de Mooij for stimulating discussions and for permission to use a document while it was still in print. The comments of anonymous reviewers of the *Systèmes d'Information et Management* have much contributed to the paper's quality.

10. REFERENCES

Ang, P.H. & Nadarajan, B. (1996), « Censorship and the Internet: A Singaporean Perspective ». *Communications of the ACM*, Vol. 39, n° 6, p. 72-78.

Bartlett, C.A. and Goshal, S. (1989), *Managing Across Borders: The Transnational Solution.* Harvard Business School Press, Boston.

Blunt, P. & Jones, M.L. (1997), « Exploring the limits of Western leadership theory in East Asia and Africa ». *Personnel Review*, Vol. 26, n° 1/2, p. 6-23.

Castells, M. (1996), *The Information Age: Economy, Society and Culture, vol. I: The Rise of the Network Society.* Cambridge, MA: Blackwell.

Craig, C.S., Douglas, S.P., Grein, A. (1992), « Patterns of Convergence and Divergence among Industrialized Nations: 1960-1988 ». *Journal of International Business Studies*, p. 773-785.

Danowitz, A.K., Nassef, Y., Goodman, S.E. (1995), « Cyberspace Across the Sahara: Computing in North Africa ». *Communications of the ACM*, Vol. 38, n° 5, p. 21-26.

Dedrick, J.L., Goodman, S.E., Kraemer, K.L. (1995), « Little Engines that Could: Computing in Small energetic Countries ». *Communications of the ACM*, Vol. 38, n° 12, p. 23-28.

De Mooij, Marieke (2000), « Viewpoint: the future is predictable for international marketers; converging incomes lead to diverging consumer behaviour » *International Marketing Review*, Vol. 17, n° 2, p 103-113.

De Mooij, Marieke (2001), *Convergence and Divergence in Consumer Behavior, Consequences for Global Marketing and Advertising.* University of Navarra, Spain: Doctoral Thesis.

De Vreede, G.J., Jones, N., Mgaya, R. (1998), « Exploring the Application and Acceptance of Group Support Systems in Africa ». *Journal of Management Information Systems*, Vol. 15, n° 3, p. 197-234.

El-Shinnawy, Maha, Vinze, Ajay, S. (1997), « Technology, culture and persuasiveness: a study of choice-shifts in group settings ». *International Journal of Human-Computer Studies*, Vol. 47, p. 473-496.

Garfield, M.J. and Watson, R.T. (1998), « The Impact of National Culture on National Information Infrastructure », *Strategic Information Systems*, Vol. 6, n° 4, p. 313-338.

Gorsuch, Richard L. (1983), *Factor Analysis.* Hillsdale: Lawrence Erlbaum.

Goulet, D. (1977), *The Uncertain Promise: Value Conflicts in Technology transfer.* IDOC, New York.

Hofstede, G. (1980), *Culture's Consequences: International Differences in Work-related Values.* Sage Publications, Beverly Hills, CA.

Hofstede, G. (1991), *Cultures and Organizations, Software of the Mind: Intercultural Cooperation and its Importance for Survival*, McGraw-Hill, London.

Hofstede, G. (2001), *Culture's Consequences· Comparing Values, Behaviors, Institutions and Organizations across Nations.* 2nd edition, Sage Publications, Beverly Hills, CA.

Inglehart, Ronald and Baker, Wayne E. (2000), « Modernization, Cultural Change and the Persistence of Traditional Values ». *American Sociological Review.*

Jaeger, A.M. and Kanungo, R.N. (eds) (1990), *Management in Developing Countries.* Routledge, London, UK.

Karahanna, Elena, Straub, Detmar W. and Chervany, L. Norman (1999), « Information Technology Adoption Across Time: A Cross-Sectional Comparison of Pre-Adoption and Post-Adoption Beliefs ». *MIS Quarterly*, Vol. 23, n° 2, p. 183-213.

Keen, P.G.W. (1991), *Shaping the Future Business Design through Information Technology*, Harvard Press, Boston, MA, 1991.

King, W.R. and Sethi, V. (1998), « Patterns in the Organization of Transnational Information Systems » in Hirschheim, R. et al. (eds), *Proceedings of the nineteenth Inter-*

national Conference on Information Systems, ICIS, Atlanta, p. 207-223.

Lievrouw, L.A. (1998), « Our Own Devices: Heterotopic Communication, Discourse, and Culture in the Information Society ». *The Information Society*, n° 14, p. 83-96.

O'Hara Devereaux, M. and Johansen, R. (1994), *GlobalWork: Bridging Distance, Culture and Time*, Jossey-Bass, San Fransisco.

Robey, D. (1995), « Theories that Explain Contradiction: Accounting for the Contradictory Organizational Consequences of Information Technology », in: DeGross, J.I. et al. (eds), *Proceedings of the sixteenth International Conference on Information Systems*, p. 55-64.

Smith, P.B. and Bond, M. (1993), *Social Psychology across cultures.* Harvester Wheatsheaf, New York.

Webster, Jane (1998), « Desktop Videoconferencing: Experiences of Complete Users, Wary Users, and Non-Users ». *MIS Quarterly*, Vol. 22, n° 3, p. 257-286.

World Bank (1999, 2000, 2001): World Development Indicators, http://www.worldbank.org

World Values Survey (2000), http://wvs.isr.umich.edu/

Zhang, K. and Hao, X (1999), « The Internet and Ethnic Press: A Study of Electronic Chinese Publications ». *The Information Society*, Vol. 15, n° 1, p. 21-30.