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Biometrics and e-Identity (e-Passport) in the European Union: End-user perspectives on the adoption of a controversial innovation

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Abstract

This study deals with user acceptability of a proposed e-Passport in the European Union (EU). E-passport is an advanced version of a combined national identity card and travelling document which holds digitised biometric features of its associated individual for enhanced security of personal authentication. We attempt here to investigate the nature of the innovation and citizens' attitudes to an e-Passport (or analogous innovation) in a range of socio-political-contexts within which the implementation occur. This paper reports the findings of an Internet Survey, conducted as the second part following a larger research program on biometrics-based e-Identity (e-Passport) acceptability and deployment issues. The data collected are interpreted under the guidance of the theoretic framework 'Price of Convenience' briefly described and fully referenced herein and theories of national culture after Hofstede [15], [16]. We found that although a *direct and complete* extrapolation of results from countries of similar cultural dimensions to another is not possible, limited referencing is still possible and provides a rather rich understanding of a country when it is used together with other dimensions of study. Although useful in helping to draw parallels between different countries, Hofstede's work is not all encompassing. Thus we also proposed other contingency factors and indicators for e-Passport acceptance which can make countries with similar cultural dimensions appear very different in biometric technological adoption.

Key words: Biometrics, electronic identity, user acceptance, adoption of innovation

1 Introduction

The focus of the research programme, an aspect of which is reported in this paper, is an understanding of the developing adoption attitude and behaviour context for an ICT-based innovation. In this paper, we take as an arbitrary ICT innovation, a proposed biometrically secured electronic identity (e-ID) or e-Passport and focus on the potential contribution of content analysis conducted longitudinally against national public media and interpreted through both the 'Price of Convenience' framework and Hofstede's model of national cultures (both described below) to structure analysis of developing adoption attitude and behaviour during its diffusion. We make no claims for the effectiveness of an e-ID initiative in enhancing national security, nor do we make any value judgements about the appropriate balance between an individual's perception of privacy loss, security (individual or societal), or convenience. We also make no claims for the efficacy of technological, procedural or legislative measures to resolve any of the issues raised. Not only is the adoption of the e-ID not the focus of our interest, but further, the e-ID itself represents only an arbitrary ICT innovation for which sufficient data is available to allow our study. We wish to understand the diffusion of arbitrary members of the class of socially pervasive ICT innovations.

1.1 Background to the e-ID/e-Passport

The terrorist attacks on mainland USA on September 11, 2001 (hereafter known as 9/11) have transformed the way governments worldwide handle security and immigration control issues. One of the responses is the planned enhancement to identification of citizens, to be deployed worldwide, and based on biometric technologies. Biometrics support automatic association of identification tokens with individuals through comparison of digitised and actual physiological or behavioural characteristics. Although there have been applications in some domains which are quite mature, such as in physical security or in the criminal justice system, the widespread deployment of biometrics has been slow due to various technical, security and standard issues.

Requirements for greater security in the European Union (EU) are driven by both internal and external factors. The introduction of the *Patriot Act* required all Passports for visitors from citizens of the so-called 'visa waiver countries' to the USA to be upgraded to contain biometric identifiers. This requirement has resulted in hurried responses to comply and heated discussions among civil libertariansⁱⁱ and privacy conscious societies. The deployment of an e-Passport in the EU is a difficult and a controversial issue. There are many reasons for this controversy, but the two most prominent are:

- the collection and later provision of biometric data is seen as an invasion of personal freedom. For many people, fingerprint identification, for example, is perceived to be too closely associated with criminality, while others report health concerns over the sharing of testing equipment; and
- invasion of privacy and personal security concerns exist over where and how the biometric information will be stored and who will have access to it.

1.2 The Structure of the Research

The study reported here comprises two parts. In the first part [21], which we briefly present in this paper, we:

- investigated the nature of a potential e-Passport innovation and the socio-political-context within which the implementation would occur; and
- evaluated, by means of a set of 10 longitudinal media content analyses (conducted in 5 EU countries and 5 countries outside the EU) current end-user perspectives on the acceptability of e-Passport by analogy with arguably similar systems already or in the process of being introduced both within and out of the EU. Our analysis was informed and framed by the *Price of Convenience* [20], [22], [25] - [28] framework and Hofstede's [15], [16] theories of national culture.

Then we report in detail, the second part of this study – the findings of a questionnaire which was designed directly to elicit opinion about the acceptability of an e-Passport-like innovation. It was tested, translated as appropriate then applied, through the WWW, to groups of MBA students studying in various countries of the European Unionⁱⁱⁱ.

This paper is organised as follows. We:

- first introduce the domain of study;
 - concepts of biometrics and biometrically-secured identity tokens, then characterise, more precisely, the concept of the e-Passport, which is the concrete innovation which forms the subject of our study,
 - briefly characterise the *Price of Convenience* framework, introduce ideas of cultural context (specifically, the work of Hofstede) which, together, structure our analytic approach,
- describe our survey approach, present and interpret our findings, and
- conclude by proposing a range of other contingency factors and indicators for e-Passport acceptability.

2 Biometrics and Electronic Identity (e-ID)

The science of biometrics can be defined as the process of locating and determining unique identifiers (physiological features and behavioural characteristics), to identify and verify individuals [7]. Biometrics encompasses a wide range of techniques – some with popular connotations of crime investigation techniques – including: fingerprints, hand and finger geometry, facial recognition, voice authentication, and iris scanning. Digitised biometric information stored on an identity token may therefore logically bind the token to a specific individual.

Identity, in information and communication technology terms, refers to the unique name of a person, device, or the combination of both that is recognised by a system [3]. The development and implementation of an identity solution requires the convergence and synergy of a number of complementary elements to provide the “what you have, what you know, what you are” key elements of a secure design. Such elements may include the underlying technologies (hardware and software), standards, control and security.

The EU Commission (2003, p. 9) used the term e-ID to denominate a smartcard based token using asymmetric cryptography and Public Key Infrastructure (PKI). As an option, the card may also incorporate a visual identity document which is a required feature for an official travel document within the EU. The main purpose of a smartcard based e-ID is to contain adequate number of private keys for the card holder and the protection of these keys against misuse. This is accomplished by specific hardware and software security features of the smart card, and the requirement for entering an authentication code (PIN and/or biometrics) before allowing the use of the private key(s) [12]. The identification of the card holder would be attained through the use of PKI-based electronic certificates which bind the corresponding public key(s) with personal data or other information (e.g. a pseudonym) which could be used to identify – directly or indirectly – the individual's identity. The certificate would, thus, be the actual digital counterpart of the visual identity document. For authentication purposes, the smartcard would enable the cardholder to prove that he is the person whose identity is stated in the certificate when the private key corresponds to the public key of the certificate. Before the certification process, the identity of the cardholder and his public key would be visually checked by the certification authority (CA). After this initial enrolment process by the CA, the usage of the stored certificates is each time preceded by checking the biometric token on the card against the actual visual inspection result. This clearly leads to a higher security level and therefore improved trust in any transaction process. It might certainly be possible to allow those types of transaction, which solely rely on the use of the certificates without visual inspection, which is the common approach in smartcard usage today (e.g. mobile phones).

While the decision to implement may have been made, and some of the mechanisms determined, the difficulty of determining diffusing the innovation – the development of broad acceptance – remains unresolved. In addition to popular associations between biometric techniques and crime investigations, biometrics itself has often been associated, in the popular press (and, therefore, we argue, in the public consciousness) with the encroachment of state control through technologies such as wire tapping and CCTV camera surveillances [5], [7]. The democratic governments of the EU nations may, therefore, reasonably be wary of introducing potentially unfavourable enabling legislation. The population of Europe may, on the whole, have become educated to the necessity of increased security but it is not clear that there is general acceptance that associated intrusions on their privacy are either a necessary or an appropriate price to pay for it. In mid-2003, when we began this empirical study, it was apparent that the populations of Member States were at different stages of understanding and acceptance – which we hypothesised to be potentially due to the diversity of social systems, cultural values and experiences of their population – exacerbated by diversity of language leading to “federation” of the debate.

We took the view, therefore, that a socio-technical study, focusing on individual nations and aiming to identify relevant non-technical issues, such as perceptions, both of citizens' fears and anticipations, was likely to be a prerequisite for the development of a strategy to support the acceptance of such a pervasive innovation across the whole of the EU. The study presented in this paper, while not definitive, supports this preliminary view.

3 The PoC Model and e-Passport

The Price of Convenience model (PoC) places the ‘balancing of costs and conveniences’ at the heart of the research framework [28]. The dimension of cost with which we are currently concerned is that of *privacy* – a fundamental concept in the debate over e-Passport deployment and a key determinant of a smooth adoption process. The e-Passport, with biometric identifiers, requires the disclosure of personal information – just as one would have to disclose location information for GPS tracking purposes in wireless applications. This information will be available to authorised organisations, especially Governmental bodies – and, of perhaps still more concern, responsibility for its non-disclosure to unauthorised bodies is ceded to the network of authorised bodies.

Similar to wireless applications, an e-Passport promises conveniences in terms of enhanced security and easier border control (in speed and accuracy). In addition, in this case, there is the potential for enhanced delivery of e-governmental services by incorporation of currently separate personal documents such as a driving licence, health and insurance card, and social security card within a single e-Passport. With the intended high security features to be built into the smartcard, proponents claim higher level of trust resulting from the deployment of an e-Passport^{iv}

The PoC is a way of looking at the entire adoption system for an arbitrary innovation, from product introduction to consumer and market response (not necessarily in this order) through the balancing of *price* (P), in terms of perceived loss of privacy against the *conveniences* (C), and perceived impact on collective *security* (S) associated with its adoption [26]. The analytic methodology with PoC at its centre, presents a way to understand interactions at three different levels:

- **primary** – the environment with three main social actors comprising the government, companies and industry groups;
- **secondary** – the media as the forth social actor, user adoption and assimilation issues (related to the diffusion of innovation), subjective norms, and facilitating conditions; and
- **consequences** – PoC balancing. Using media as proxy for the general feelings of the community, we extract issues related to privacy, security and convenience (P-S-C), employing a conceptual mining/semantic analysis technique^v for extracting and then visualising changes in (P-S-C) over time; the issues surrounding the changes; and then the consequences.

As Figure 1 shows, the system can be described as: ‘primary authority adoption determinants’ acting through the public media, indirectly and generally independently, on end user attitude and adoption behaviour which is also affected through subjective norming channels and facilitating conditions. The public mass media, in addition to acting as an information and opinion dissemination channel, can be considered as a proxy for societal attitude and thus to provide feedback to the primary authority adoption determinants. Naturally, it also provides an indirect mechanism through which the four main classes of actor within the determinant group influence each other. Both end user attitude and behaviour influence the attitude and behaviour of other end users – directly through subjective norming, and indirectly through reports in the media.

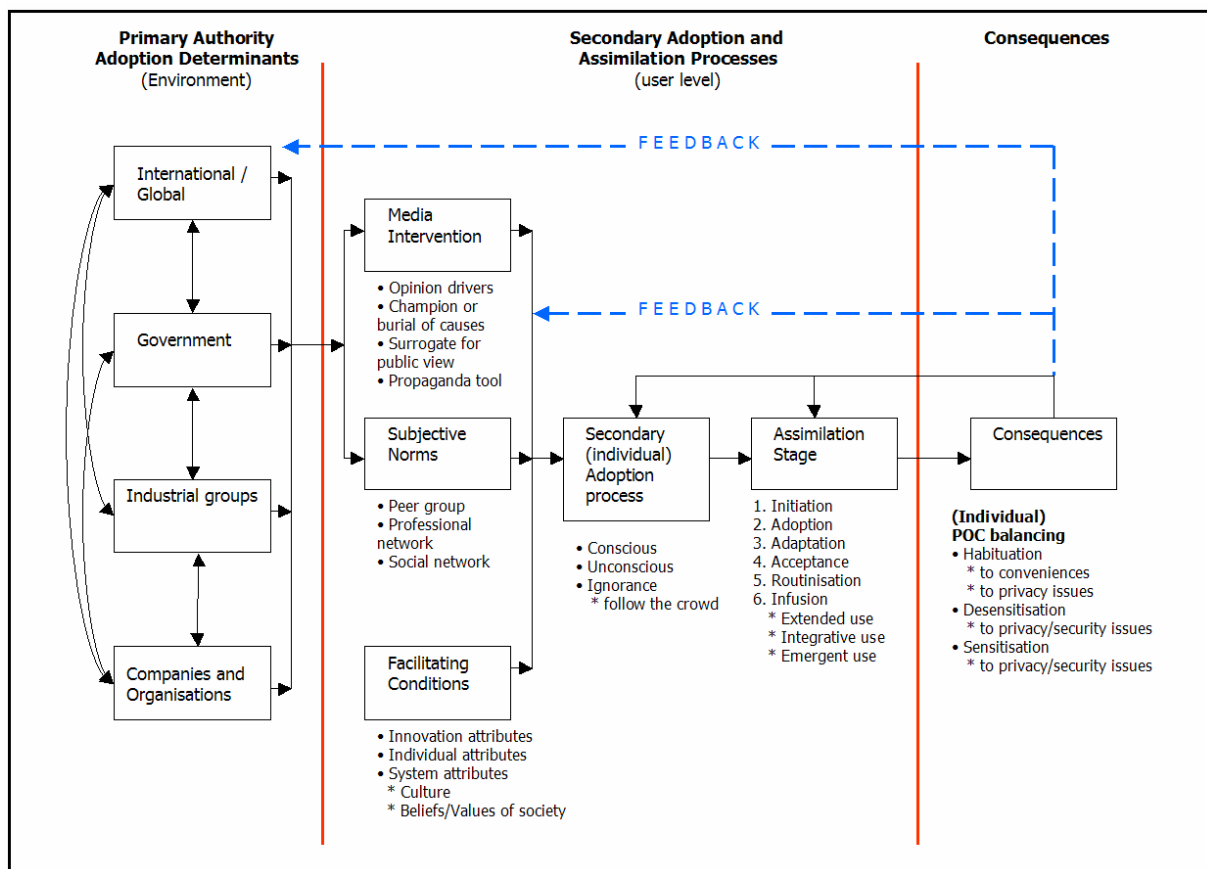


Figure 1: Research model and focus of analysis

The PoC model described above and illustrated in Figure 1 is adopted in this paper to guide understanding of the dynamics of the roles of various actors in the implementation of a biometric e-Passport.

Although, a Government may have the power, in theory, to introduce laws to ensure full adoption of e-Passport, a Government is ultimately answerable, at the ballot box, to its population. Consider, for example, the introduction of

the Euro. A strategy for the introduction of e-Passport would require successful market introduction which, in turn, means successfully identifying the need for the innovation.

Introducing a social tool such as e-Passport requires social changes which begin with the most committed segment (in Rogers' terms, the Early Adopters) – either technologically or socially-internationally driven and ultimately extend through other segments until it finally covers the entire population. When under time pressure, the Government may push or accelerate this change process through aggressive media propaganda, though normally stopping short of a total enforcement – see, for example, the deployment of MyKad by the Malaysian government [35].

4 Culture and the adoption of innovation

In the first part of this research^{vi} [24], we have demonstrated through media content analysis, the context within which the debate about an e-Passport (or similar innovation such as an e-ID smartcard or a multipurpose smartcard) – as characterised by the national press – varies significantly from one nation to another.

Media content analysis is a research tool used to determine the presence of certain concepts within texts or sets of texts by seeking certain words or word sequences associated with those concepts. Media content researchers quantify and analyse the presence, meanings and relationships of such words and concepts within texts, then make inferences about the “messages” contained within the texts, the writer(s), the audience, and even the culture and time of which the texts may be said to form a part. Content analysis began as a quantitatively oriented textual analysis method for studying mass communications. Later it was broadened beyond statistical semantics of political discourse to include qualitative analysis of its semiotics (symbolic meaning) [17]. Until the advent of widely available computing power, content analysis was a time consuming process. Analysis was either performed manually, or slow mainframe computers were used to analyse cards containing data punched in by human coders. Human error and time constraints made this method impractical for large texts. Despite its impracticality, however, by the 1940's content analysis was already a fairly widely used research technique. Although initially limited to studies that examined texts for the frequency of the occurrence of identified terms (word counts), by the mid-1950's researchers were starting to consider the need for more sophisticated methods of analysis, focusing on concepts rather than simply words, and on semantic relationships rather than just presence [8]. While both traditions still continue today, content analysis is now assisted by various computer tools and programs (such as Leximancer, Thomson ISI's RefViz^{vii}, SPSS, SAS, etc) are also utilized to explore mental models, and their linguistic, affective, cognitive, social, cultural and historical significance.

In this study, Leximancer^{viii} was used to support the development of the concept set, on the basis of which the data was selected, organised and analysed – see [26], [29] for a description of this development. Empirically, our study examined elements of two of the three Adoption and Assimilation processes set out in the general research model (Refer Figure 1) – *media intervention* and *facilitating conditions*. The third factor-set, *categorical norms*, cannot be addressed at the cross-national level we have concerned ourselves with in this work. Below, we discuss the research method employed in the analysis of *media intervention* – Media Content Analysis, and our bases for selecting countries for inclusion in the study on a comparative cultural basis—Hofstede's analysis [15], [16]. The balance of the section is concerned with discussion of the implications of country-level results for *PoC Balancing* on an EU versus non-EU (referent country) basis.

We postulate here that this is a natural consequence of national targeting of news stories generally, enhanced by language differences. Irrespective of the reasons, however, the national press provides, in some sense at least, a basis for describing the national context for any debate [2], [4]. We have also shown that the characteristics of the context of the national debate over biometrically-secured e-IDs can be explained, at least in part, by reference to its national culture represented in terms of Hofstede's five dimensions described as follows [15], [36]:

- **Individualism (IDV):** The degree of which the people of a country view themselves as either “self-sufficient individuals” (individualist) or as an “integral part of a social group” (collectivist). This factor concerns the tendency of people to look after themselves and their families, to the neglect of wider society. Individualism may be contrasted with an opposing tendency to subordinate *perceived* immediate self-interest to Collective welfare. In our study, while the IDV score associated Great Britain (rank 3/53) is extreme – matched only, in our Part 1 study, by the referent country USA (rank 2/53) – IDV is generally fairly high within the EU country sub-sample. This Hofstede dimension speaks directly to the PoC Balancing problem of anticipating attitudes towards e-Passport initiatives across national cultures. Prospective Adopters of e-passports are being asked to sacrifice *individual* privacy for collective security (a PoC Balance decision)—a value-rational decision-making problem we have discussed elsewhere [30]^{ix}.
- **Uncertainty avoidance (UAI):** The degree of which the people of a country attempt to avoid or to deal with uncertainty. Countries with high score will tend to use laws, regulations and control to keep uncertainty low (for example, see [37]). Countries with low UAI are greater risk takers and are more open to change. Taken in isolation, the influence of this dimension is likely to be negative in relation to e-Passport and similar initiatives - high UAI ranking suggest relatively low tolerance for PoC risks associated with e-Passport. On this dimension (and as shown in Table 1), Greece's rank constitutes an extreme position (UA rank = 1/53). When considered without reference to Greece's outlier position, the EU sub-sample is characterized by low UAI. Considered in

aggregate, then, we would anticipate modest PoC challenges for the e-Passport initiative in relation to this dimension.

- **Power distance (PDI):** The degree of which the people of the country would be willing to accept an unequal distribution of power^x. Higher PDI ranking promotes inequality reflected by large power and wealth differences. Whereas very low PDI indicates equal opportunities. Highly equalitarian countries are geographically diverse (ranging from Australia to Israel) yet a 'critical mass' of low PDI EU countries is to be found in Scandinavia. As shown in Table 1, Denmark was rank-ordered at 51/53 and is included in the present study. At the other extreme, individuals in countries ranging from South America to the Middle East tend to exhibit high levels of tolerance for power inequality – high PDI. Within the EU sample, Greece provides the best match with a moderately high score on this dimension (26/53 PDI rank), followed by Spain (31/53 PDI rank). In general, the EU countries studied manifest low tolerance for PDI (significantly lower than that manifested by the referent countries – excluding the USA – in Part 1 of our study). All other factors equal, more resistance to e-Passport and comparable government-sponsored initiatives is to be expected in relatively low PDI cultures as the risk of privacy loss associated with the imposition will be perceived as less *legitimate*.
- **Masculinity index (MAS):** The degree of the values that are predominant in a country. Countries with high masculinity carry high levels of gender differentiation due to male domination. Countries with low masculinity reflect greater equality. On this dimension, both the EU and non-EU samples offer well-distributed values (see Table 1).
- **Time orientation (LTO):** The degree of which the people of the country view their perspective in life. A long term orientation would indicate a society that stresses actions that affects the future, while a short term orientation would indicate a society that stresses the present or the events of the past. Since the conceptual relevance of this dimension to the present topic is not apparent it will not be discussed further.

To summarize, the two sub-samples (EU and non-EU) are broadly comparable in the range of media-relevant cultural differences extant and a reasonable distribution of values on four relevant dimensions of culture has been obtained.

We characterise Part 1 of our study, briefly, here because we utilise some of the findings from that study in our analysis of the results of the survey that forms the main focus of this paper. In Part 1, more than 41 media sources were used, primarily digitised printed materials such as online press releases and databases. Because e-Passport implementation targets the whole population, we aimed to be as inclusive as possible in terms of data sources – in particular, we attempted to avoid collecting only the voice of the educated middle-classes. We did not fully succeed in attaining this goal – there is, unfortunately, a clear bias in the 'voice' which is available in digitised format. Nonetheless, the data available to us presented clearly differentiable stories and clearly differentiable 'critical concepts in the debate' from one national context to another.

Two sets of sample countries were selected for Part 1 of our study:

- EU member countries: Germany, Great Britain, Spain, Denmark and Greece (also the focus of our Part 2 survey, reported here); and
- Non-EU reference countries: Malaysia, USA, Taiwan, South Korea and Japan.

The Non-EU reference countries were selected for this project on the basis that they provided the opportunity to explore contexts in which diffusion of biometric-based ID systems had been attempted (some successfully, some not); and because we were able to identify research assistants with appropriate 'mother tongues' and were thus able to derive clear perceptions and reactions of citizens towards biometrics and biometric ID systems.

A summary of scores obtained from [15] on the sample countries are shown as Table 1 below. Long term orientation is not included here as the scores are not available for all sample countries.

| | | Hofstede Dimension of Comparative Culture (Score/ Rank on 53 sample countries) | | | |
|------------------------|---------------|------------------------------------------------------------------------------------|---------|---------|---------|
| Country | | PDI | IDV | MAS | UAI |
| Reference Countries | Japan | 54 (36) | 46(22) | 95 (1) | 92 (7) |
| | Malaysia | 104 (1) | 26 (36) | 50 (25) | 36 (46) |
| | South Korea | 60 (25) | 18 (43) | 39 (41) | 85 (11) |
| | Taiwan | 58 (28) | 17 (45) | 45 (32) | 69 (27) |
| | USA | 40 (38) | 91 (1) | 62 (16) | 46 (44) |
| EU Member Countries | Denmark | 18 (51) | 74 (8) | 16 (48) | 23 (51) |
| | Germany | 35 (44) | 67 (15) | 66 (9) | 65 (30) |
| | Greece | 60 (26) | 35 (30) | 57 (18) | 112 (1) |
| | Spain | 57 (31) | 51 (20) | 42 (37) | 86 (17) |
| | Great Britain | 35 (42) | 89 (3) | 66 (9) | 35 (48) |

Table 1: Hofstede's Cultural Characterisations for Sample Countries

Culture has always been considered as one of the factors influencing the implementation of a new technology [36]. The underlying argument for this is based on the premise that a community's beliefs and values (i.e. culture) can affect the attitude and behaviour that in turn either promotes or demotes the implementation of technological change. There has been a significant body of research supporting the influence of national culture on values and behaviour, indicating fundamental value differences when the similar technology is implemented in different national environments [18]. Only until recently is national culture being featured actively in technology acceptance research and in information systems [10], [36].

This study uses the work of Hofstede as an explanatory theory for analysis of the way in which culture may affect technology acceptance. We attempt to extrapolate, in a probabilistically predictive manner, from findings obtained from reference countries to EU member countries. Hofstede's data indicate there are cultural differences between the EU member countries. This is by no means a surprise; one of the main characteristics of continental Europe is its apparent cultural diversity. When attempting to cluster the countries together we can derive the following matches (later in the paper, we illustrate how these dimensions can be one of the indicators of end-user attitudes towards e-Passport acceptability):

- Germany stands out with a strong UAI and a weak PDI score. Matching countries in this category are Switzerland, Austria, Hungary, and Finland;
- Spain stands out with a strong UAI and a higher PDI. Matching countries in this category are Italy, France, Belgium and Portugal;
- Greece stands out with a strong UAI and higher PDI and MAS. Matching countries in this category include Slovenia, Croatia, Serbia (Balkan countries), Russia and Turkey;
- Great Britain stands out with a weak UAI, a low PDI and a high IDV. Matching countries in this category are Ireland, Sweden, Norway, Denmark (Scandinavia except Finland), Netherlands, and Italy; and
- Denmark stands out with a high IDV and low MAS. Matching countries in this category are Sweden, Norway, Finland and Netherlands.

To summarize, three of the Hofstede dimensions of culture (UAI, PDI and IDV) in comparative context appear to speak directly to the concerns of e-Passport Adoption Authorities, both within and beyond the EU. Variance in dimensions of culture suggest that conditions of Adoption and Assimilation will be facilitative in some national contexts but detrimental to acceptance of change in others as *PoC Balancing* weighs into behavioural responses. Further, our general model suggests that these factors will enter into Media Intervention pertaining to the public issue.

5 Findings of Part I

We summarise below our indicative findings from Part I, then illustrate a synthesis of them in Figure 2.

- **Developing a favourable environment:** An e-ID is more likely to be found acceptable if the population has been effectively educated about the needs and reasons for increased security – and the potential impact of the e-ID in delivering such increased security. Education might, in a variety of contexts, be driven by issues such as illegal immigration, terrorism, benefit fraud and e-government requirements. Mechanisms such as governmental public relation activities, promotional and educational advertisements and normal media releases form potential mechanisms for such education. The creation of a favourable environment should be carried out over the entire deployment process. As observed in the media content analysis and its effects on the awareness and perceptions of EU citizens, the media plays a critical role in providing an arena for debate. The PoC model takes into account the media as perhaps 'the' key player because of its influence in shaping the debate and education on technology and privacy. As people are more exposed to the media, with regard to biometrics, e-Passport and related issues, the higher the possibility that citizens will begin to form a societally coherent opinion. The four actor classes in the PoC model (*government, industry, company, society*) can all contribute to promoting the debate.
- **Create understanding and awareness of the biometrics:** The next step is the creation of awareness and the understanding of biometrics technology as a solution for the external and internal problems. Active discussion through media and consultation programs can promote citizen awareness and understanding. This process is similar to that of developing a favourable environment, but the focus changes to biometrics. The technology should be launched by the industry leaders, opinion formers and innovators. Descriptions and images of where the technology will be used need to be built. To build acceptance within the population as to the legitimacy of this technology, an informal consultation processes could be set in place.
- **Develop references and provide experience opportunity:** To create positive perceptions of the systems, successful case studies at both country and company level could be used and debated with opinion former groups, media and populations. The themes should be centred on associating perceived contextual problems with biometrics as the solution. In addition, the population should have a personal experience of biometric identification in their daily environment. Without appropriate knowledge and experience, biometric technology could be regarded as a Big Brother surveillance system and not as a daily security tool. The use of advanced technology can bring familiarity with the e-Passport. For instance, South Korea and Japan show a high penetration of technology products including Internet and mobile phones. South Koreans and Japanese have a more favourable attitude towards advanced technology, due to their exposure to them in daily life. Biometric identification is seen as an attractive future technology in both these countries. There are many applications of

biometric identification that are already used and can be introduced. Biometric authentication is in existence today in Columbia and Japan with ATM machines and has lead to familiarity with the technology. Fingerprint authentication in personal computers can easily demonstrate the benefits of enhanced security and convenience when users no longer need to memorize long passwords. In Germany, a few video rental shops provide a 24-hour service for customers who have registered their fingerprint and use biometric customer cards. As more citizens are exposed to biometric identification, they will be persuaded more easily to realise the benefits of enhanced security and convenience. Additional benefits of the card over existing systems must be clear to the population for a successful deployment. Individual companies can develop future applications of biometric identification. However, the Government's role in diffusion of biometrics is critical in the legislative area as a method of reassuring the general public, and trust building.

- **Launch of e-Passport:** The form of the technology and the vehicle should be agreed upon among EU member countries. The chosen form and contents should meet at least a level of universal standard to function as an identification tool. This study has identified the most preferred types of biometric identifiers (fingerprint and iris) and additional functions (driving licence and national ID card). It is necessary to be careful with the level of functional introduction. Countries with low UAI (e.g. Denmark) are found to be more open to new developments. However, as the survey revealed, in reality only one or two services are preferred on the card. The limited amount of core function can also reduce the concern of privacy, particularly in high UAI countries like Germany. In the initial stage of introduction, a limited amount of information will be easier to accept. The system should also be voluntary in the initial parts. Depending on national environments, local authorities should have the freedom of choice concerning selection of the additional functions in order to reduce concerns of privacy. Within the standard EU Passport system, the application of the e-Passport looks friendlier to EU citizens when it is country dependently customized. In addition, logistical problems relating to legacy systems, means plans need to be initiated that involve extensive lead times, and the operational problems of working simultaneously with paper and card based systems.

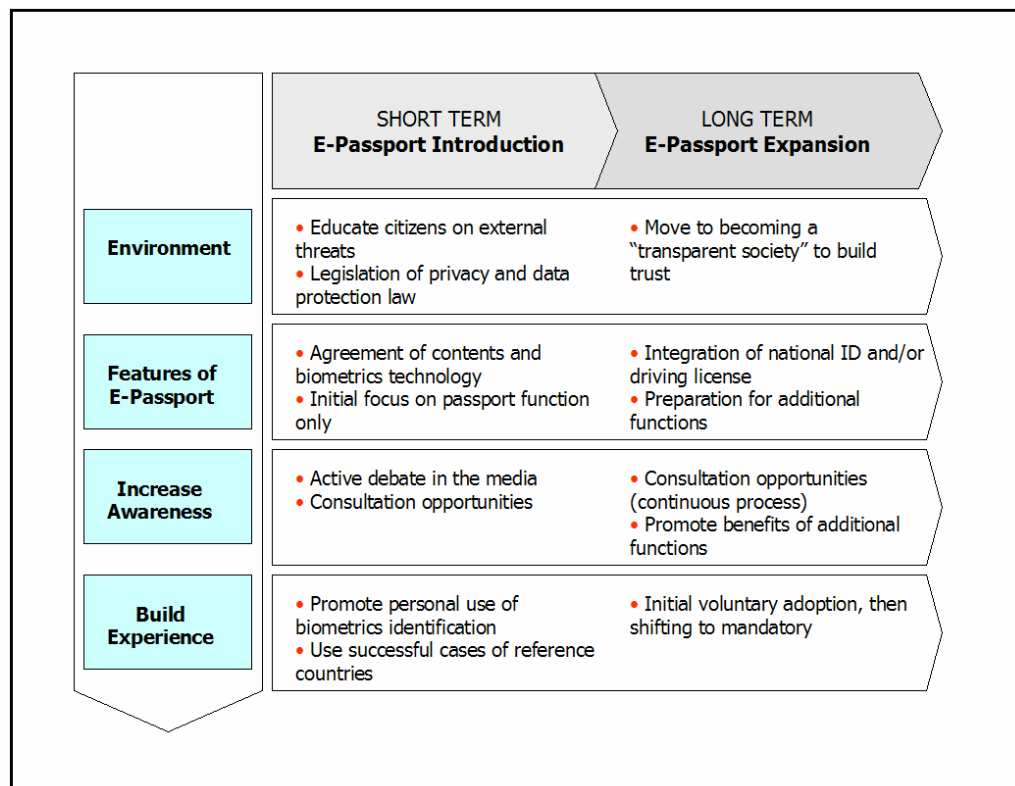


Figure 2: Summary of Findings for e-Passport Deployment Plan

5.1 Limitation of the e-Passport Implementation

The member countries have different social and historical backgrounds. The implementation of a single format of Passport is likely to face various contingency factors, some of which could be resolved, some not. A universal approach would still require customisation to encompass country specific environments.

- **Existence of cultural diversity:** The cultural links can be used as a broad-brush approach but for greater detail, it is necessary to take account of the cultural criteria that flavours the approach used.

- **Technological advancement level in each country:** Considering the technological advancement of the e-Passport in comparison with the conventional one, the technological development level plays a pivotal role in shaping the EU citizens' perception and behaviour.
- **Existence of legacy system:** National ID system exists in most countries, and passport systems in all countries. Old systems could hinder the introduction of the new. Investment in infrastructure in the more technology advanced identification countries such as Germany and France can be a barrier to adoption. On the contrary, the newer members such as Greece, where an ID system doesn't exist, will find that an absence of legacy systems will allow for a speedier adoption of biometric systems. Legacy systems include not only existing ID systems, it also includes in country biometric manufacturers and PKI infrastructure.

6 Internet Survey

The exploratory nature of our data analysis calls for descriptive statistical methods in order to extract a broad understanding of the issue we study. This will allow the generation of a set of specific hypotheses in a next step of research. In addition, our experimental design as the sampled data described in this section does not support the strict requirements that inferential statistical methods are based upon.

We now move to the main focus of this paper, our survey of comparable 'slices' – of Information Systems/eCommerce literate MBA Students – of the populations of the five EU nations selected, specifically in terms of their opinions of and reactions to a proposed e-Passport. Although the introduction of an e-Passport would be a consequence of action by an EU decision-making body, the distinct background of each member country makes it necessary to understand underlying rationale within and reactions from each member country individually. This survey instrument design was founded on the theoretic framework of the PoC Model [20], [26], [28] briefly described above. This framework identifies three focal concept sets: *convenience*, *privacy* and *security* which, we have argued, are balanced by prospective adopters of an innovation.

The media content analysis of the previous research part reveals the interaction between four key players/classes of player; the *Government*, *Industry*, individual *companies* and *Society-at-large*. Users, influenced by – and to some extent influencing in their turn – these interacting players [player classes] through the mass media, have an individual attitude and behaviour toward the e-Passport. This survey is applied directly to individuals and aims to build attitude profiles and to detect whether there is an observable relationship between the national context for the debate and the attitudes of individuals exposed to that context.

In order to establish comparable population samples from the five EU countries studied in Part 1, we identified colleagues teaching MBA classes in Information Systems or eCommerce at universities in: Great Britain, Germany, Spain, Greece and Denmark who were willing to facilitate our application of this survey instrument to their students. While we recognise that these samples are not reflective of the overall populations of their respective countries, we argue that they are, at least, comparable sample groups. There is almost a 100% penetration of Internet to MBA students. Therefore, the web-based nature of the survey had less resistance than might normally be the cause and anticipated a sample relatively aware of the issues we were studying (we expected the sample to be skewed towards Roger's "early adopter" category).

The English language questionnaire consisted of three sections: screening, main and demographics. The major questions were on the awareness of biometrics identification and on the perception of e-Passport (Please refer to the Appendix 1 for an outline of the Structure and Content of the Questionnaire). The instrument was applied between October 2003 and November 2003. Those interviewees, who lack Internet access skills, were unintentionally excluded from the participation. Consequently, the respondents for this survey may be presumed more IT-literate and possibly more technology-sensitive than a general population.

A sample size of at least 50 respondents per country was considered to provide a meaningful representation of the educated, technology sensitive segment of the population. In practice, the web survey could only be applied to 35 respondents from Spain, and 21 from Greece but the target sample size was achieved in all other countries studied. Even though response numbers in Spain and Greece did not meet the target representation level, the result still provides useful descriptive indications of important issues for individuals within each country.

6.1 Findings

6.1.1 Demographics of the respondents

A total of 303 respondents were obtained (See Figure 3). Excluding 34 responses from citizens outside the geographic coverage area of the project, 269 responses were considered in our analysis. The highest number of respondents were from Germany $n=99$ while the lowest response was from Greece $n=21$.

64% of respondents were male; 57% are aged in their 20s, 28% in their 30s. 22% of total respondents have educational qualifications higher than bachelors level. 92% of respondents currently possess a passport. The highest rate of the Passport possession was amongst Danish respondents (97%) and the lowest amongst Greek

respondents (86%) – adequate to justify the sampling relevance. 38% of respondents have resided overseas for longer than six months – a high mobility level.

The sample population, therefore, can be characterised as being young, well educated both in general and, in particular, in relation to the issue under discussion. In addition, the subject of the study was perceived to have some personal impact on those questioned.

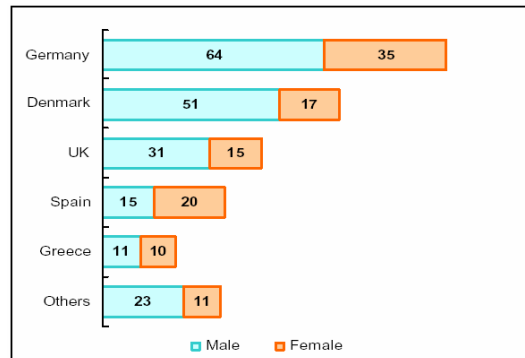


Figure 3: Profile of respondents by country (N=303)

6.1.2 Awareness of biometrics

There was a generally high level of awareness (average 65%) of biometrics across the whole sample. The highest levels were from Germany, Spain and Denmark (71%, 70% and 69%, respectively). Great Britain and Greece showed moderate awareness (54% and 43%, respectively).

- German national culture is considered to exhibit a high level of uncertainty avoidance, in fact, the highest level in Western Europe [15]. Unsurprisingly, therefore, discussions on this new technology and its effects on privacy invasion in the mass media have been active and multi-perspective and have increased the awareness of biometrics generally and the adaptation of biometrics into national identification systems in the country (see research Part I) [21]. In our Part I analysis of German media content, we considered human rights groups to be the initiators of 27% of relevant media stories and to be much more active in this regard than either Industry or Government. Consequently the media enhances the weight of the privacy concept within the social context.
- In the case of Spain, the results reflected a sudden peak of interest. Coincidentally, immediately prior to the web survey, an article on the biometric identification in the US was published by a large Spanish newspaper '20 Minutos'. This newspaper was distributed to local students without charge, thus increasing awareness dramatically almost overnight.

6.1.3 Perception of the e-Passport

Taken overall, the survey suggested that informed EU citizens of the five countries surveyed might feel quite positively toward a proposed passport secured with biometric information (57% responding positively, 13% responding negatively). In fact, however, there is a quite marked difference in perception between countries. The most attractive implications of an e-Passport were perceived to be protection from forgery and crime and, thus, enhancement of personal security. A simplified and shortened identification process was also recognised as a benefit. Convenience factors such as usage as a multi-function (identification/bank access/medical record/social security/driving licence/etc) card and national security benefits – for example as a tool for protection from terrorism – were not strong enough arguments to attract users.

The most important negative aspect of the proposed e-Passport was invasion of privacy (mentioned by 30% of negative respondents) in information collection while other perceived disadvantages were all related to safety/security of the information – the fear of illegal access and abuse of personal information. Denmark had both the highest level of awareness of biometrics and the most positive view of the proposed e-Passport of any country studied (41% - selecting [1] "Extremely favourable" on our Likert scale); while Greece (only 5% positive) exhibited the greatest level of negative feeling about the proposal.

In terms of technology diffusion, Greece lags behind other EU member countries. Economically, Greece has a high dependence on agriculture and tourism, and a lower competence in high-tech industries. Lack of debate in Greece resulted in a low awareness of biometrics and may have led to the minimal acceptability we encountered.

We summarise our results in Table 2 and note that these are consistent with the balancing of concerns of convenience, security and privacy as premised by the PoC Model.

| Perceived Positive (N=150) | | Perceived Negative (N=30) | |
|---------------------------------------|-----|---------------------------|-----|
| Protection from crime/fraud | 29% | Privacy invasion | 30% |
| Security | 19% | Abuse of information | 13% |
| Speeding up of identification process | 8% | Access to information | 13% |
| Convenience | 8% | Monitoring/Surveillance | 10% |
| Innovative technology | 5% | No benefits to citizens | 10% |
| Accurate identification | 5% | Accuracy of technology | 7% |
| Additional functionalities | 5% | | |

Table 2: Perceptions of e-Passport adoption

6.1.4 Information sharing with other organisations

Negative respondents see e-Passport as having significant negative privacy consequences. Except in Denmark, respondents expressed particular concern about information access. Only 23% of respondents felt comfortable with information accessibility by *other* organisations than those that they had specifically authorised – and worry about potential abuse of their personal information by unauthorized bodies. Even positive respondents state data safety as a precondition. Storage of electronic data is perceived to be questionable.

The level of concern about information security is linked to the amount of information stored in the e-Passport. The more data is stored, the more concerned the prospective user. There exists a certain level of concern over information sharing. Only 23% of the respondents are unconcerned ('feel comfortable' and 'feel very comfortable' combined) at the prospect of different organisations accessing biometric information. Greeks, in particular, express a great concern (57% of respondents 'feel very uncomfortable' or 'feel uncomfortable'). Danes, by contrast, seem to be comfortable with the information access. Denmark has already established a central database for all of its citizens that functions as an identification system.

The degree of comfort with broad information access appears correlated with overall impression of the e-Passport.

| Reasons for Positive Reactions (N=62) | | Reasons for Negative Reactions (N=117) | |
|---------------------------------------|-----|----------------------------------------|-----|
| Safety of data should be guaranteed | 32% | Abuse of information | 30% |
| Authority holds this information | 10% | Privacy (private information) | 12% |
| One-fit-all card is convenient | 6% | Too much information on one card | 8% |
| Only for government use | 3% | Safety of data | 4% |
| Separate financial information | 3% | Separate financial information | 3% |
| | | Only for government access | 3% |

Table 3: Reasons given for reaction to the possibility of information access by other organisations

The respondents, who are favourable to information access by other organisations, still share a concern about the security of the data. 30% are concerned over information access (the who and the what) as a possibility for third parties. For instance, an insurance company might make use of the medical information to increase the insurance premium, or spam mail for commercial purposes. The integration of the identification and other personal information on the e-Passport presents a 'risky outlook' for the respondents who are against. 8% are uncomfortable of a 'one-fit-all' card, which contains, in their opinion, too much information in one place, while 3% requests separation of the additional information from the identification information.

6.1.5 Preferred type of biometric identifiers

Fingerprint and iris identifiers received the highest preference from the respondents with 57% and 53% each. Fingerprints have already been used as an additional identification mechanism in many national ID systems and thus are found more acceptable. Iris scanning attracted many positive respondents in spite of the fact that it is not widespread technology for identification. It seems that generous coverage in movies like the *James Bond* series, *Minority Report* and *Mission Impossible*, has helped portray iris scanning as inherently attractive to this sample.

6.1.6 Attribute test of the e-Passport

The clear majority of the respondents (64%) agree that an e-Passport would increase protection from forgery while only 48% view e-Passport as an anti-terrorism vehicle (See Figure 4).

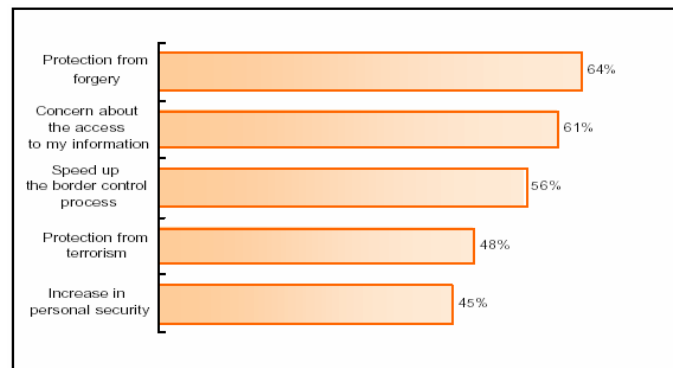


Figure 4: Favourable attributes of e-Passport (N=269)

Figure 5 demonstrates that the Greek sample exhibited relatively weak agreement to almost all attributes of e-Passport. The perception of each national sample to attributes of protection – from terrorism to process improvement in immigration border control – was heterogeneous. The cause could be a consequence of differing national contexts or of differing national cultures – we are unable, at this time, to do other than speculate. For instance, at the time of the study, the UK and Spain were most aligned with the US's anti-terror activities. These two countries recorded the highest agreement (59% and 60%, respectively) for the anti-terrorism potential of e-Passport. Both historically and at the time of the survey, Spain by the activities of the Basque separation movement lead by ETA while UK may be influenced by the activities of the IRA.

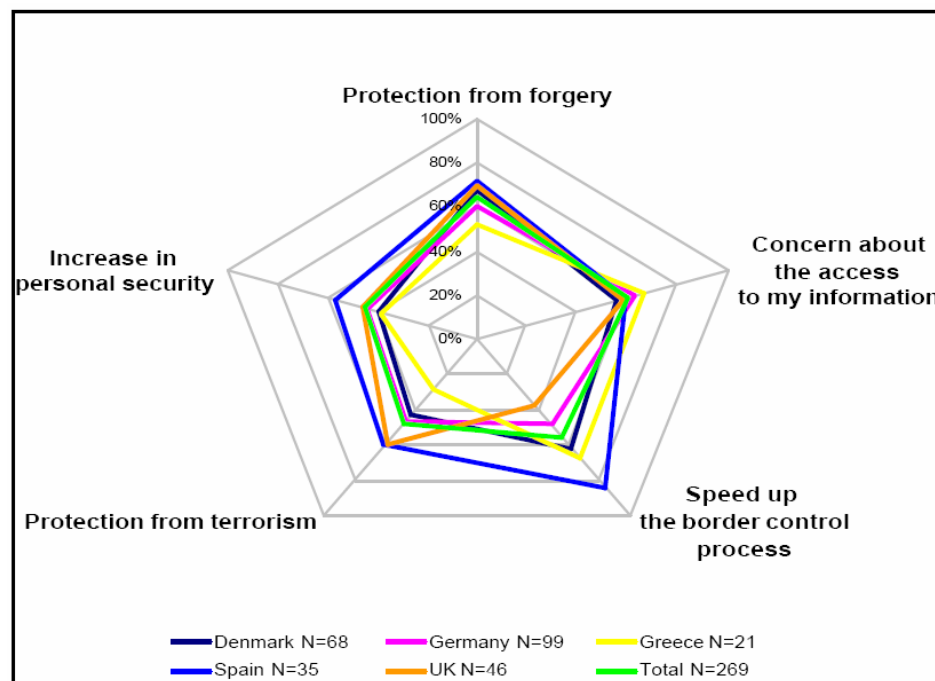


Figure 5: Country by country agreement to the attributes of e-Passport

6.1.7 Preferred Additional Functions of the e-Passport

The most common ID card carried by an EU citizen is the driving licence. In our sample, this was closely followed by employee/student identification cards. In countries where the national ID card is mandatory, the carrying rate for such a card is similar to that of the driving licence. As preferred additional functions on e-Passport (see Figure 5), the driving licence and national ID card, unsurprisingly, received the highest response. Interest in overloading the e-Passport with other functions such as bank and credit cards remained low at around 20%. This reaction correlates with the information access and the privacy issue. Respondents feel insecure that their personal information, particularly financial, could be inappropriately accessed. Interestingly, Danes not only preferred more additional functions on the e-Passport than respondents from other countries but, uniquely, amongst our sample were more positive about the prospect of an e-Passport the more the e-Passport was overloaded. We speculate that this is a consequence of experience of the Danish central citizens database – that is, it is a habituation effect. Our media content analysis (Part I of this study) showed that Danes are more exposed to such information sharing than any other European citizens.

Additional functions beyond those already discussed, such as social security, home access and medical insurance functions appear controversial and finance-related functions were very poorly supported. Danes, once again showed a higher level of acceptance for even these additional functions, on average 10% higher than other countries, for each function.

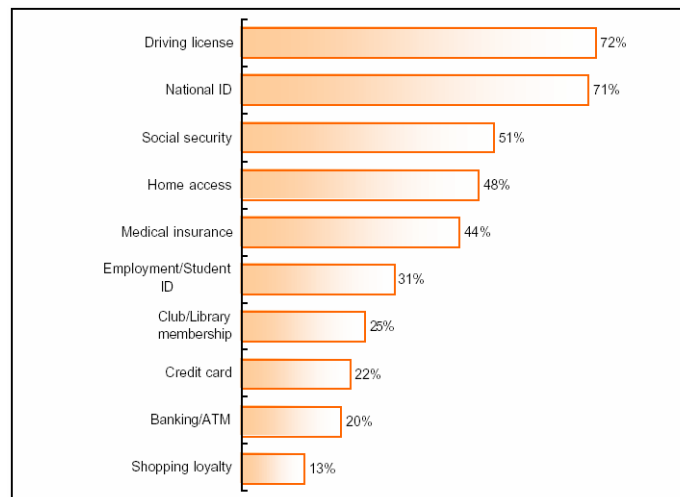


Figure 6: Preferred additional functions of e-Passport (N=269)

6.1.8 Improvement through the e-Passport

When respondents were considering the proposal for an e-Passport as a whole, enhanced security and convenience are motivators for adoption – reduced cost and privacy protection are not seen as potential benefits. This confirms the perception that an e-Passport would have only a negative effect on individual privacy.

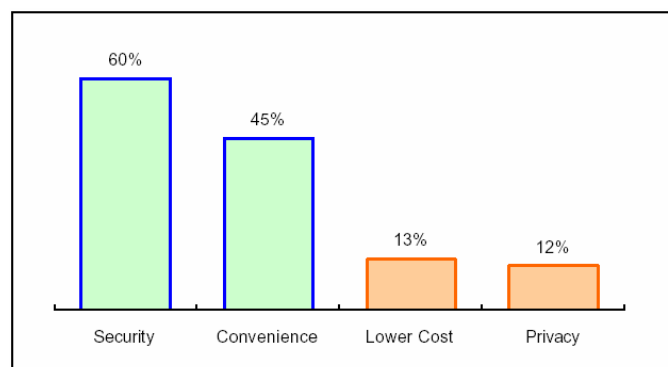


Figure 7: Expected improvement through e-Passport (N=269)

On average, 50% of respondents are likely or very likely to apply for e-Passport when it contains only identification information. The application intention goes down to 42% for an e-Passport with additional functions such as credit card access. As mentioned above, the Danish response was unique and interesting. Media content analysis in Part I, indicated that Danes may be characterised as technology-oriented and have generally high level awareness of the issues surrounding biometric identification. Spanish respondents exhibited the most significant negative variation of adoption intent as feature overloading was suggested with application intention amongst the sample declining from 63% to 37%. In general, it appears that a multi-functional e-Passport would be perceived by EU citizens to be risky. Female respondents showed higher level of application intent than males (56% versus 47%) for a basic e-Passport but were, by far, more significantly affected by the prospects of feature overloading: adoption intention amongst female respondents dropped from 56% to 37% while intention amongst male respondents was little affected, dropping from 47% to 45%.

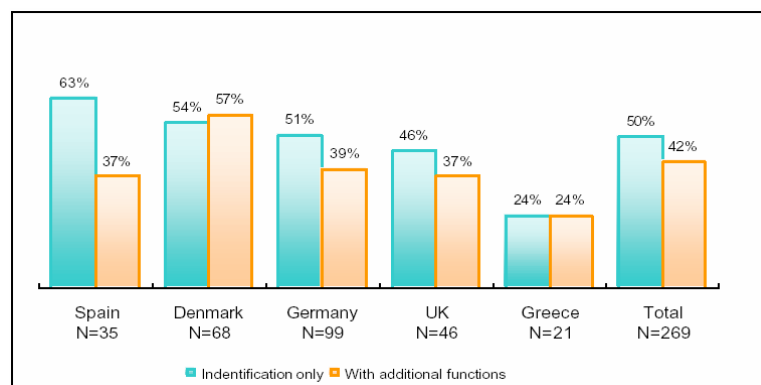


Figure 8: e-Passport: Application intention

6.2 Cultural Commentary

6.2.1 Germany

There appears to have been strong, relatively 'objective' reporting of issues and significant debate surrounding biometric identification over the last few years in Germany. The required law for biometric data in IDs has already been passed and approved, but actual implementation will take a longer time to materialise. The media has contributed to the scepticism of German citizens. Biometric opponents further took advantage of the hesitant population to slow down the implementation process.

The US media suggested that Germany could be one of the first EU countries holding biometric features on their national ID. However, due to a resistant society, Germany might actually be one of the last countries implementing it. There is a critical balance to be managed between technological advancement and data privacy laws.

Hofstede's analysis for Germany shows high levels of IDV, MAS, and UAI. PDI is ranked considerably lower than the others and illustrates Germany's belief in equality and the rights of the citizen. Potential for upward mobility is a feature of German culture. A consequence is, however, that the decision-making process in Germany has a significant consensus component and thus decision making and implementation is a lengthy process with a focus on security and assurance. Rules and regulations are a prerequisite, characterising the country as rather risk averse. Quick changes are, therefore, not easily accepted.

In Germany, therefore, an e-Passport implementation could not be introduced the way it was in Malaysia as German Society is resistant to a government directed implementation and, indeed, to the concept of a central database of personal data. Public awareness has been raised through the media and the privacy-security-convenience debate in the German media was the most intense of any of the countries studied. In order to convince Society to agree upon a new national ID system with embedded biometric data, the advantages of security and convenience would have to outweigh the respect for data protection and the fear of a potentially 'high' error rate. Germans will not easily give up their perceived freedom for an unclear enhancement of security.

Security is, however, of great importance – and this is one factor promoting e-Passport introduction. However, the long decision making process can be expected to be a barrier to deployment.

6.2.2 Denmark

Analysis of Danish culture highlights a high level of trust in Government and the general concern on security within Society. Denmark has the lowest level of UAI, PDI, and MAS amongst the sampled countries indicating that rules and laws that protect individuals are prized. Danish society does not support great inequalities in power and wealth. Denmark is more open to changes than is, for example, Germany, and is thus more flexible. People, therefore, tolerate behaviours and opinions different from their own because they do not feel threatened by them and they have a tendency to feel relatively secure. The reduction of uncertainty is not a pressing concern.

There is no national ID card in Denmark but all citizens are registered in the National Civil Registry and have a personal identification number (CPR). As the CPR is widely used, citizens (Society) are eager to have their privacy protected. Therefore, the Government invests significant effort to convince its citizens of any new innovations. Society requires complete trust in the systems, and the public sector requires a high level of security to handle a large part of the electronic transactions with the citizens. A digital signature for citizens, companies, and public institutions is a major component of Denmark's e-Government strategy. Based upon the survey by World Economic Forum (Nov. 2002), the country reveals the highest trust towards its government in the world. Citizens' concerns over personal/social security are likely to be the key argument in any debate over the acceptability of a proposed biometrically secured passport.

6.2.3 Spain

The fast growth and development of Spain during the last 30 years has required the Spaniards to accept rapid change and also to welcome new technologies which are expected to, in the long run, improve the country's economy. Our survey indicated no "in principle" opposition to an e-Passport proposal. Spanish opinion has been influenced by two main factors: security and immigration. Spanish culture reflects a high UAI ranking which indicates a relatively high level of anxiety in people as they try to create a secure environment. Spain shows little tolerance for ambiguity, and the high levels of PDI – reflected in a hierarchical power structure – suggest the possible responsiveness to a Government promoted biometrically secured passport initiative.

6.2.4 Great Britain (GB)

Britain has deeply ingrained suspicion of national ID Cards. The British media seized upon any proposals (e.g. Youth Cards, Entitlement Cards, and Health Cards) as subversive approaches by the Government. Biometrics, as an identification technology has similarly become enmeshed within this debate. The one area to have escaped from extreme negative press is Smart Passports; this may be due to public acceptance of Passports as a necessity. This specific area of acceptance has not escaped the attention of the Government, which will proceed to use Biometric Passports as the tool to push for higher levels of identification, with national IDs as the potential ultimate goal.

The cultural dimensions of Great Britain include high IDV indicating a loosely integrated Society focusing on self-interest at the expense of group-interest. Britain has a low ranking in UAI, indicative of a society that has few rules and does not attempt to control all outcomes and results. Britain also has a low level of PDI indicating that equality of influence between societal levels, Government, organisations, and families is important. Britain is flexible and responsive to new initiatives generally (it has a low UAI index), and is especially responsive to those initiatives which are perceived to potentially boost the economy. However, Society's opinion is of great importance the Government were to wish to introduce an e-Passport. British society seems unlikely to blindly accept a proposal for a biometrically secured ID card and is likely to favour involvement in the decision making process.

6.2.5 Greece

Greece displayed rather different cultural features to the other EU member countries studied. A very low score in IDV and a high score in PDI, might suggest that Greeks should feel comfortable with the Government's plans and abide by them. The industrial structure of Greece remains underdeveloped, with the most important industries being agriculture and tourism.

With regard to the e-Passport, Greece is driven by a strong economic motivation and attempts to enter the realm of a "developed market" within Europe [33]. A key driver of Greek economic development is the process of convergence with the rest of the EU countries. Greece is the largest beneficiary (with Spain) of financial aid from the EU. Thus compliance to EU standards becomes a necessity.

In June 2003, all EU countries gathered in Athens to discuss the implementation of biometric passports. A trial version of biometric passports were scheduled to be issued to Greek citizens sometime in 2004 [9]. As seen in the national ID implementation, the affiliation of religion might come up again as an issue for the e-Passport in Greece. Considering a weak level of discussion and debate among social actors in Greece, the Greek Government initiative is expected to play a key role in implementing any EU requirements.

Greek society exhibits an extremely high level of UAI consequently ambiguity is unwelcome and Greeks, especially the older generation, have a preference for tradition over change. A moderate degree of MAS and PDI emphasize the centralization of authority and somewhat autocratic leadership within Society. However, low IDV indicate that

Greeks, like many Mediterranean's, have strong group ties and the people are tightly integrated within their communities. Similar to Spain, Greek society places great emphasis on security.

The e-Passport could, in principle, therefore, be acceptable to Greek society and security would be an important aspect of the national debate. A key factor would, however, be the support of the Greek Orthodox Church (to which approximately 98% of the population belongs). The Church opposed a change to the National ID card when religious belief was removed from the information contained thereon (BBC, Jan. 2003).

7 Other contingent factors and Indicators for e-Passport Acceptance

It is not adequate to interpret the findings solely through Hofstede's cultural dimensions. On one hand it provides a possible explanation to generalising attitudes and behaviour of the adopting population, on the other hand many other contingency factors [19] exist that need equal attention, and other indicators that can be used in parallel in order to understand user acceptability issues and to promote the take off of the e-Passport initiative.

7.1 Contingent factors

According to [13], other 'people' issues to be considered in diffusion and adoption of an innovation include: culture-tradition, risk averseness, knowledge level and user acceptability. Described in the case of e-Passport in relation to the issues or constraints that might influence its adoption process would be the following:

- **Cultural aspects:** The Hofstede cultural analysis revealed interesting assumptions regarding the four cultural dimensions. The similarities and references of EU and non-EU countries revealed how these countries are culturally compatible in some aspects but have different attitudes regarding new technology innovations, such as South Korea and Greece, for example. High UAI suggests a more difficult and longer adoption process of new technology, and higher PDI indicates that a top-down introduction hastens the adoption process. Cultural aspects influence the adoption process, in the time frame required for acceptance and complete deployment.
- **Prior acceptance of national ID cards:** The countries within the EU are at various stages of acceptance of national ID cards. Some have used them for some years (Germany) and others have only recently introduced plans to adopt them (United Kingdom). Bearing in mind it took the Netherlands almost eight years from the official start of the debate until physical distribution of ID cards; one should not underestimate the importance of previous experience of similar innovation.
- **Prior acceptance of biometrics into identification systems:** Biometrics technology is a controversial technology and its adaptation into e-Passports and other such identification systems has so far been a controversial one. Governments of the EU are at various stages of acceptance as are their populations and this also severely impacts a country's position of diffusion of technology. It should be mentioned that Greece and Spain's government show willingness to accept biometrics due to the high funding they depend on from the EU, and that although Germany's government has approved its implementation, political debates about the actual implementation of biometrics in ID cards is still ongoing. The UK's main concern was with the actual card itself, the information biometric or otherwise was of lesser importance.
- **Trust in government:** The level to which a Government is trusted and accepted by its population will impact acceptance. In societies with high power distance, this trust might not be as influential as in countries with lower power distance, for example. It should be stated that within the EU the ranges are not considerable but the influence is strong enough for it to have an effect upon a country's position. The corruption perception index (CPI) be used as one of the measurement instruments. The Transparency International or TI Corruption Perceptions Index (CPI) this year ranked 102 countries in terms of the degree to which corruption is perceived to exist among public officials and politicians. It is a composite index, drawing on 15 different polls and surveys from nine independent institutions carried out among business people and country analysts, including surveys of residents, both local and expatriate. The CPI focuses on corruption in the public sector and defines corruption as the abuse of public office for private gain. This index can be used as a base for indicating the depth of trust between population and the governments of the reference country's studied. The level of trust and willingness to accept propositions from a government would be a barrier or supporter of an innovation such as the e-Passport.
- **Level of security:** The level of perceived security within a country has an impact upon the likelihood of acceptance of the e-Passport. We observed the change in opinion towards security measures post 9/11. Ideally a country assessment of the relative safety would have been preferential to a city assessment. However, the research conducted proved unsuccessful in identifying a suitable survey index that covered the countries this report is interested in. Therefore the capital cities for the countries researched were used as security indicators.
- **Mercer Human Resource Consulting^{xi}** compiles what is termed a 'Quality of Life' index for all the leading cities around the world. The survey takes into account various criteria, such as personal security, political consideration, economic consideration and several others. These criteria have different weightings in the overall survey reports. Thus personal criteria as one criterion has more weight than the others. The criterion, personal security, is an area that is critical to the e-Passport adoption. Personal safety scores are based on crime levels, law enforcement, and internal stability. Cities are ranked against New York as the base city, which has a rating

of 100. The analysis is part of a worldwide quality of life survey, covering 215 cities, to help governments and major companies to place employees on international assignments.

- **The perceived level of security** within a country or in this case city is a contributory factor to the adoption of an e-Passport (as identified in the media content analysis from Part I). We found that a country with a requirement for security will be more likely to adopt a technological innovation such as the e-Passport.
- **Immigration level:** The EU is experiencing high levels of immigration, both legal and illegal and is unifying its protection of its borders. The BBC news revealed that in all of the researched EU countries, Spain and the UK's immigration has increased over the last few years whereas in Germany and Denmark immigration has decreased due to tighter restrictions. However, the problem of illegal immigrants is not the problem of one single country. The governments of the EU, despite objections from free rights and racial groups, are using this issue as a reason for greater identification security over citizens and visitors, *this should be seen as a positive influence for biometrics introduction and provides forward momentum for the introduction and acceptance of the system.*

The media content analysis from Part I [21] and cultural analysis from both Parts revealed that the German population is not yet eager to accept the biometric technology. Denmark does not see a particular need in implementing a national ID with biometric features because the state already maintains a central database and an open policy even though the media expressed some social security concerns. Germany, however, shows scepticism due to privacy and accuracy reasons. The UK expressed some insecurity within the population mainly because they seem to associate any biometrics with the national ID card, which is unpopular. Spain expressed no true opposition and Greece would comply to EU standards since it depends greatly on its funding. However, technology, security and trust of the government body remain critical aspects in the final innovation adoption process positioning

7.2 Indicators for e-Passport adoption

7.2.1 Internet penetration

The Internet penetration study is one of several indicators commissioned by the UN [34] for measuring and tracking improvements in the human conditions^{xii}. The survey has collated information over the last five years to measure the number of Internet users per 100 of the population. The level of use of the Internet is an indicator of how technologically aware a country is. The ease with which a country adopts to this technology is an indicator of its probable acceptance of other technologically intensive systems such as the biometric Passport. The populations of Germany (38.4%), UK (57.2%) and Denmark's (62.7%) have higher Internet access levels compared to Spain (24.7%) and Greece (9.9%). Hence, the countries revealing higher Internet penetration could be placed in the biometric technology adoption process as early majority or even as early adopters. Spain and more so Greece would represent here the late majority and possibly even laggards since the populations do not seem to be eager to enrich its technology standards. However, it has to be taken into consideration that all five countries Internet's penetration have increased steadily over the last four years indicating an increasing level of technology awareness and acceptance.

7.2.2 E-readiness index

Another possible indicator of technology acceptance is the e-readiness index. The Economist's Intelligence Unit's e-readiness rankings [32] provide an established benchmark for countries to compare and assess their e-business environments. "E-readiness", or the extent to which a market is conducive to Internet-based opportunities, taken into account a wide range of factors, from the quality of IT infrastructure to the ambition of government initiatives and the degree to which the Internet is creating real commercial efficiencies. Covering the world's 60 largest economies, the rankings suggest areas in which government policy and funds can be focused.

They also provide a useful guide for multinationals seeking to invest in technologically innovative countries and tailor their Internet strategies to local conditions.

The index is used to allow positioning of the reference countries in relation to the level of acceptance of technology. The index goes up to 100 and the higher the score the more technologically innovative the country is. How likely is Country A to accept a technological innovation such as an e-Passport when compared to Country B? These two-technology indicators that place the EU studied countries, offers some contradictory analysis with our prior results in the media content analysis. According to the media analysis, Germans, for example, oppose this new biometric technology for several reasons, whereas the Spanish would be inclined to accept it in spite of its low Internet penetration rate and low e-readiness score. The Greeks, although demonstrated to be least technology responsive country in both technology indicators and in the media analysis, however, by being dependent on EU for funding, the government would probably comply to EU's request.

7.2.3 Scoreboard for Environmental Analysis

The Scoreboard proposed here is modified from [11]. It can be used to map the EU countries to track the evolution of the innovation (e-Passport) over time and the factors that influence these changes (See Appendix 2). The Scoreboard complements the PoC model (and empirical study such as e-Passport here) by providing a way to quantify *part of* the findings. It serves as guidelines for potential statistical analysis. It allows for identification of

groups (e.g. countries, communities or clusters) that are similar across the structural and socio-cultural indicators; and for identification of structural and socio-technical-cultural indicators that may be correlated with measures of innovation adoption readiness. It uses a range of proxy indicators that are easily available to users. And because of its frequent updates, this option provides a more robust and “all-rounded” innovation and diffusion indicators as compared to, for example, the cultural dimensions of Hofstede [14] - [16]. Where the PoC-based media content analysis and the internet survey will tell the story of *why* something occurs and the *consequences*, the Scoreboard will tell us quantitatively more environment – the primary and secondary level indicators, including socio-technical and conditions of innovation/adoption.

The Scoreboard can be used here to illustrate richer extraction of deployment and adoption issues. As mentioned in the preceding chapter, the Scoreboard consists of two main categories that influence the innovation acceptability and its diffusion capabilities. The first consists of structural, economic characteristics, economy and the distribution of economic activity by sector. The second category relates to socio-technical issues and conditions that encourage or inhibits innovation acceptability and its diffusion capabilities. Both categories are used here as main determinants of trajectory of end user adoption of an biometric-based passport, through possible extrapolation from the national level to the user level, thus enriching the depth of content analysis that was based on the PoC Model.

8 Conclusion

The Internet survey was conducted to help understand the reaction of the EU citizens and complements the results from our Part I media content analysis. The survey was directed to audiences of MBA students (and selected employees of companies) within Europe using over 300 respondents. Several interesting conclusions were derived. The survey population as a whole recorded over a 65% rating for knowledge of biometrics. As a consequence of the nature of the sample this figure, we suggest, overstates the appreciation of the general population, suggesting that awareness in the public-at-large needs to be improved. Their knowledge of biometric systems leads us to conclude that Iris and Fingerprint-recognition systems are likely to be the most preferred methods of identification and therefore these systems should be considered first for implementation into ID systems. Finally, a clear preference was measured in the respect of applications with Banking and Government types of applications (driving licence, national ID and passport). These views, however, differed markedly from country to country and by gender – consequently there is a limit to the practicality of a ‘one-size-fits-all card’.

The results of both parts of research could be interpreted and analysed, in part, using cultural-based interpretation of the countries. Cultural dimensions, as identified by Hofstede [15], [16], impact the way populations accept or reject innovations. Therefore, being familiar with a country’s culture can be of great advantage in order to change or adjust the perception of the population towards new innovation, such as biometric identity. Although a direct and complete extrapolation of results from countries of similar cultural dimensions to another is not possible, limited referencing is still possible and provides a rather rich understanding of a country when is used together with other dimensions of study. In Part I, Non-EU countries and EU countries that seemed superficially to be so different proved to be similar (although in limited aspects) according to Hofstede’s dimension analysis. We found power distance and uncertainty avoidance as most useful for the e-Passport study as they demonstrate a population’s interest in being involved in governmental decisions and also the level that a group would feel comfortable without knowing all information. Although useful in helping to draw parallels between different countries, Hofstede’s work is not all encompassing and it is important to understand that other contingent factors, such as technology adoption, can make countries with similar cultural dimensions appear very different in biometric technological adoption. In addition it would be necessary to extend the study to cover other similar e-Passport deployments within the EU. Austria, for example has recently released their Biometric Identity Card^{xiii}, which has in turn pushed for e-government initiatives in Europe^{xiv}. The relevance of the subject will continue on and well into the future, both as a source for debate as well as the driver for future innovations of which biometrics will be based upon.

The diffusion of socially pervasive, ubiquitous ICT innovations is a challenge to predict due to complexity of the interactions between the innovation and the adopting unit, in this case the *society*. This interaction may result both in re-conceptualisations of the essential nature of the innovation itself and, perhaps even in significant changes in society – which, itself, becomes an agent of change which redefines the birth of new innovations or forces the evolutions of existing ones [23]. This e-Passport empirical case, classified also as ‘interpretive case study’ [38] contributes to our theory development project that support and extend studies of adoption of innovations. The dynamics of which the innovation occurs are examined and analysed within an interpretive paradigm which is discussed in greater detail in another paper [23]. This project has several novel aspects. The field of study is approached repeatedly, from the development of a conceptual framework [28] to the finalised research model (see Figure 1) so as to develop a contextual basis to allow for the study to focus on what is relevant in a particular context. We designed our study as longitudinal, in that data are collected over a period of time as the events were taking place. This enabled us to gain access to the complex and shifting nature of the context: including actions, reactions, and feedbacks. In addition, we acquired the knowledge of two selected innovations – that of e-Passport which is presented here, and that of mobile commerce applications reported in other papers [25] - [27], the different motivations for adoption, and the changing contexts within which the attempted deployment was taking place. The theoretical basis of our study evolved over time in response to both our deepening understanding gained through the

collection of the field data and our changing ideas resulting from the iterative cycles of research through continuing study of the IS literature in related fields and empirical studies.

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Appendix 1: Contents of Internet Survey

| Section | Contents | Structure |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Screening | <ul style="list-style-type: none"> • Gender • Age • Passport holder • Nationality • Current residence country • Experience of overseas residence | All closed-end answers |
| Main body of Questionnaire | <ul style="list-style-type: none"> • Awareness of biometrics/ biometrics identification • Holder of different ID cards • Perception of e-Passport (first thing that comes to mind) • Acceptance attributes of e-Passport • Comparison of e-Passport to conventional travel document • Preferred form of biometric identifier(s) • Acceptance of personal information on e-Passport • Acceptance of additional function on e-Passport • Perception of privacy invasion of e-Passport • Behavioural: Adoption of e-Passport • Pricing issue | Mainly structured (Likert scale: 1 – 5) or Yes/No. 2 open-end questions for reasoning. |
| Demographics | <ul style="list-style-type: none"> • Education background • Occupation | All structured |

Appendix 2: Structural and Socio-Technical-Cultural Indicators for e-Passport Evaluation and Diffusion in the European Union

| STRUCTURAL INDICATORS Categories | | Relevant Data Sources |
|-------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------|
| 1 | Demand potential for innovations | |
| | GDP per capita | Eurostat: Structural indicator ^{xv} |
| | Young/Old ratio | Eurostat: Demographics ^{xvi} |
| | Average time for sales to takeoff (years) | [31] |
| 2 | Industry Structure | |
| | Percent of all private sector value added (primary, manufacturing & services) from private services. | OECD (STAN) ^{xvii} |
| | Percent of all manufacturing value-added from low med-low technology manufacturing. | OECD (STAN) ^{xviii} |
| 3 | Trade Openness | |
| | Transnationality Index ^{xix} | UNCTAD, World Investment Report ^{xx} |
| | Trade openness: Imports + exports of goods and services divided by GDP. | Eurostat: Structural indicator ^{xxi} |
| | Foreign-funded R&D as a percentage of total R&D | Eurostat: Structural indicator ^{xxii} |

| SOCIO-TECHNICAL-CULTURAL INDICATORS Categories | | Relevant Data Sources |
|---------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| 1 | Receptiveness to new ideas | |
| | GDP per capita Percent students from abroad | OECD – Education at a glance |
| | Languages: percent of population that can converse in at least one foreign language | Standard Eurobarometer 55 ^{xxiii} |
| | Urban households | EUROSTAT (Urbanization rates) |
| 2 | Attitude towards risk | Eurostat: Structural indicator |
| | Positive attitude to self-employment | Flash Eurobarometer ^{xxiv} 134 |
| | Positive attitude to starting a financially risky business | Flash Eurobarometer 83 |
| 3 | Social capital | |
| | Trust | European Values Study Survey ^{xxv} or World Values Study Survey |

Endnotes

- ⁱ The “Patriot Act” was criticised heavily by civil libertarians, a legislation they felt gave too much power to law enforcement. Source: TIME (2004), “Resigned: John Ashcroft”, November 22. p.17
- ⁱⁱ Further readings on the impact of information technology on civil liberties can be referred to the works of [6] S. G. Davies, Big Brother: Australia's Growing Web of Surveillance. Sydney: Simon and Shuster. 1992.; or [1] P. E. Agre and C. A. Harbs, Social Choice about Privacy: Intelligent Vehicle-highway Systems in the United State, Information Technology and People, vol. 7, no. 4, pp. 63-90, 1994.
- ⁱⁱⁱ While it was recognised that the subjects studied were not representative of the general population of the countries in which they were studying, the sample groups were comparable with each other and thus provide an opportunity for a qualitative, empirical investigation of the impact of contextual culture on responses to such a proposal.
- ^{iv} See for example: http://www.bundesgrenzschutz.de/Auto_Grenzkontrolle/index.php Bundesgrenzschutz (Accessed on 9 December 2004) Schnell und bequem - erledigen Sie in ZGBunft Ihre Grenzkontrolle einfach selbst Die "Automatisierte und Biometriegestützte Grenzkontrolle" (ABG) auf dem Flughafen Frankfurt/Main, Updated on 22 March 2004.
- ^v LEXIMANCER (www.leximancer.com) data mining software was used earlier within this programme of research to develop the characteristic concept set utilised in the MCA reported here.
- ^{vi} InSyL Working Paper 2005/1, *Advance Computing Research Centre*, University of South Australia. Submitted for publication in archival literature.
- ^{vii} K-Praxis (September 14, 2003) “Automated Content Analysis: Review of Recent Trends”. http://www.k-praxis.com/archives/content_analysis/automated_content_analysis_review_of_recent_trends_p.html Accessed on January 6, 2005.
- ^{viii} See <http://www.leximancer.com/overview.html>
- ^{ix} At first blush, we would be inclined to anticipate high levels of Adoption and Assimilation resistance associated with this dimension of culture in the US (which, internationally, ranks second only to Australia on this measure). However, Americans are much less likely to need or hold passports than are nationals of EU countries and so, for many, the PoC issue is moot.
- ^x The power distance dimension and the individualism dimension are negatively correlated. However, Hofstede stresses that power distance and individualism are two different constructs and should be treated as such.
- ^{xi} Mercer Human Resource Consulting (March 2004), “World Wide Quality of Life Survey”. Source : <http://www.mercerhr.com/summary.jhtml/dynamic/idContent/1128760>, Accessed on February 15, 2005.
- ^{xii} Millennium Project Homepage. Task Force on Science, Technology, and Innovation: “Innovation: applying knowledge in development”. Source: <http://unmp.forumone.com/index.html> Accessed on February 11, 2005.
- ^{xiii} Refer to: http://www.buergerkarte.at/index_en.html. Accessed on July 12, 2006.
- ^{xiv} For more information see: http://www.austria.gv.at/site/cob_17167/4522/default.aspx. Accessed on July 12, 2006.
- ^{xv} Refer to the Statistical Office of the European Communities at: <http://europa.eu.int/comm/eurostat/>
- ^{xvi} Refer to the Statistical Office of the European Communities at: <http://europa.eu.int/comm/eurostat/>
- ^{xvii} Refer to Organisation for Economic Co-operation and Development (OECD)'s STructural ANALysis database (STAN) Indicators Database at: http://www.oecd.org/document/54/0,2340,en_2649_201185_21573686_119656_1_1_1,00.html.
- ^{xviii} Refer to Organisation for Economic Co-operation and Development (OECD)'s STructural ANALysis database (STAN) Indicators Database at: http://www.oecd.org/document/54/0,2340,en_2649_201185_21573686_119656_1_1_1,00.html.
- ^{xix} Calculated as the average of FDI inflows as a percent of gross fixed capital formation, FDI inward stock as a percent of the year's GDP, value added of foreign affiliates as a percent of GDP, and

employment of foreign affiliates as a percent of total year's employment. [11] European-Commission, 2003 European Innovation Scoreboard: Technical Paper No5 National Innovation System Indicators, European Commission Enterprise Directorate-General, Brussels, 2003.

^{xx} United Nations Conference on Trade and Development (UNCTAD)'s World Investment Report focuses on trends in foreign direct investment (FDI) worldwide, at the regional and country levels and emerging measures to improve its contribution to development. Every issue of the Report has: (1) analysis of the trends in FDI during the previous year, with especial emphasis on the development implications; (2) ranking of the largest transnational corporations in the world; (3) in-depth analysis of a selected topic related to FDI; and (4) policy analysis and recommendations. Refer to <http://www.unctad.org/Templates/Page.asp?intltemID=1465> for further information.

^{xxi} Refer to the Statistical Office of the European Communities at: <http://europa.eu.int/comm/eurostat/>

^{xxii} Refer to the Statistical Office of the European Communities at: <http://europa.eu.int/comm/eurostat/>

^{xxiii} The Standard Eurobarometer survey series is a unique program of cross-national and cross-temporal comparative social research. See http://www.gesis.org/en/data_service/eurobarometer/standard_eb/

^{xxiv} Flash Eurobarometer, launched by the European Commission in the late 80s, complements the Standard Eurobarometer survey series. The Flash includes special target group polls, the data are free for secondary analyses one year after the fieldwork date. See http://www.gesis.org/en/data_service/eurobarometer/flash/ for more details.

^{xxv} Refer to European Values Surveys at: <http://www.europeanvalues.nl/index2.htm> or World Values Surveys at <http://www.worldvaluessurvey.org/>. The "Human Beliefs and Values", a cross-cultural sourcebook based on the European Values Study 1999/2000 and the World Values Survey 2000/2002 was merged and published based on data from 13 countries. Surveys were carried out between the period of 1995-1997 but not in 1999-2002. The sourcebook discusses issues on: Perceptions of Life, Environment, Work, Family, Politics and Society, Religion and Morale, and National Identity. For more details refer to the following website: http://www.niwi.knaw.nl/nl/maatschappijwetenschappen/steinmetzarchief/new_2/new_2/