

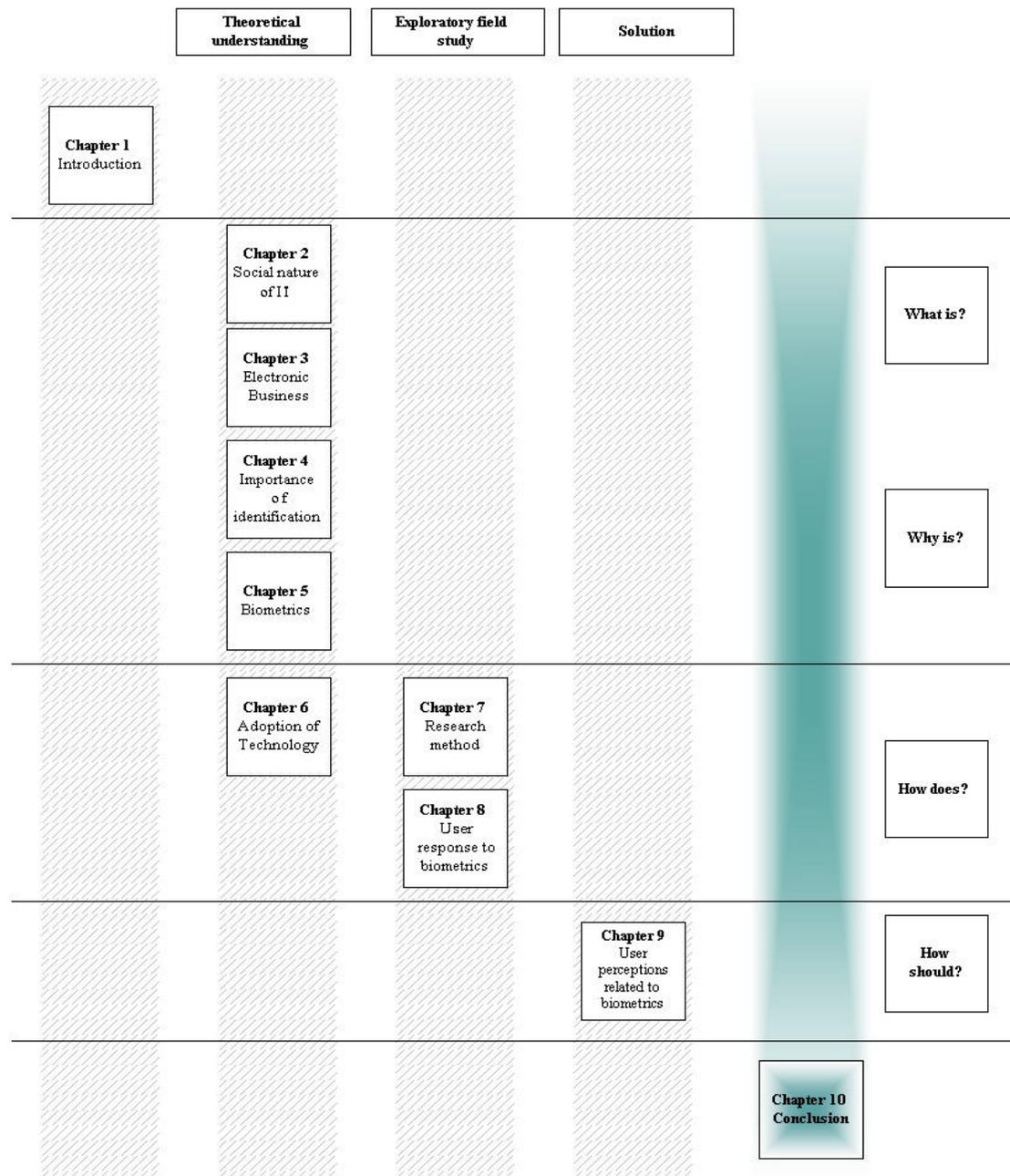
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10. CHAPTER 10: CONCLUSION

“Man has been endowed with reason, with power to create, so that he can add to what he’s been given.”

Anton Chekhov

Figure 10-1: Thesis roadmap – Chapter 10



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10.1 Introduction

This chapter provides a research study conclusion, a research study evaluation and recommendations for future research studies.

10.2 Research study conclusion

Chapter 1 – Introduction, provided some background to the research study problem statement and objectives by means of a research study motivation section and it was concluded that user perceptions (social factors) will play an important role in the implementation of identification through biometrics in Electronic business. Thereafter the actual research study problem statement was defined as: **The identification of user perceptions related to identification through biometrics within electronic business.**

Chapter 2 – The social nature of Information Technology, stated (Chan 2002) that Information Technology has had a radical impact on Information Technology users, their work and their work environments. In fact, Information Technology plays a role in many, if not most, of the everyday operations of today's organizations. This statement leads to the exploration of the social nature of Information Technology. Roode (1993) suggests that Information Systems support and facilitate human and social processes through Information Technology, and contribute towards a meaningful work life for the users within an organization. It was concluded that Information Systems are developed by people for people and are therefore, rooted within human nature (social context).

Chapter 3 – Electronic Business, discussed social factors that could impact on the user adoption of Electronic Business, and possible social factor solutions proposed by other researchers, and included:

- It was concluded that **trust amongst participants** is needed within Electronic Business. When a foundation of trust is in place it can contribute to the success of both a traditional business and Electronic

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Business, arguably more so to the latter because of the significant reduction in human-to-human or face-to-face interaction (So and Sculli 2002). Ratnasingham (1998) suggests that trust within Electronic Business can be obtained by using a trusted third party, ensuring individuals that their information is kept secure and perhaps even by putting proper legislation in place.

- It was further concluded that trust amongst participants in Electronic Business entails that both **security and privacy considerations** need to be addressed simultaneously (Udo 2001). Individuals' privacy concerns can be addressed by compiling a privacy policy and publishing it on the website in question (Karakaya 2001) and to ensure e-transacting security organizations should again use a security policy as a basis and perhaps suggest that they will be willing to share some of the risks should something go wrong (So and Sculli 2002).

Chapter 4 – The importance of identification, first defined the term identification. It was concluded that identification was always social rather than economical in nature, but as the complexity of economic transactions developed the need arose for accurate identification (Clarke 1994). A variety of means of identification are available, but it was concluded that biometric identification is based on physical and difficult-to-alienate characteristics of an individual and is further claimed to provide greater confidence that the identification is accurate (Clarke 1994). Therefore, for the purpose of the research study, biometric identification methods were discussed as the preferred means of identification.

In **Chapter 5 – Biometrics**, it was concluded that all biometric systems function in a similar way, but it is important to remember that the ease of enrolment and quality of the template are critical success factors in the overall success of any biometric system (Allan 2002b). Biometric methodologies were categorized as physiological or behavioural biometrics. These can offer

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a strong method of authentication in a wide variety of applications that can help to recognize individuals and speed up the access processes (Allan 2002b). User perceptions with regard to security and privacy considerations were identified as social factors that need to be addressed as part of user adoption when making use of biometrics as an identification method within Electronic Business (Soutar 2002). It was concluded that biometric identification methods should be sold to individuals as a privacy-enhancing technology (PET), convincing them that it will act as a privacy protector instead of a privacy invasion technology (Albrecht 2002a).

The last chapter that formed part of the theoretical understanding section, **Chapter 6 – Adoption of Technology**, emphasized that user adoption decisions have little to do with any supposedly innate characteristics of new innovations, but rather with specific uses of the innovation that relates to their social interactions and environment. Davis's (1989) technology acceptance model (TAM) that deals with the adoption and diffusion of technology in society was discussed. The model focuses on user perceptions, which include perceived usefulness (PU) and perceived ease of use (PEOU), **two** important perceptions that guide the adoption of unknown technologies by users, as they will create either a favourable or unfavourable disposition in the user towards using the innovation or not (Davis 1989). Davis (1989) postulates that individual perceptions about "how-useful-is-this-for-me?" and "how-easy-is-it-to-use?" are another **two** important perceptions that influence the adoption of technology. The above factors from the technology model selected for the research study were incorporated with the theoretical contribution sections found within previous chapters (Chapter's 2-5) of the research study to create the initial Technology Adoption Model compiled for the research study problem statement.

Thereafter, the exploratory field study section of the research study attempted to enhance the Technology Adoption Model compiled by gathering user

perceptions regarding the Internet, Electronic Business, biometrics and user adoption. The exploratory field study section was undertaken by means of an interpretive research method, which was discussed in **Chapter 7 – Research method**.

Chapter 8 – User response to biometrics, indicated that most of the employees that responded to the questionnaire regarding Internet/e-banking/on-line purchasing and conducting e-transacting on behalf of their organization had concerns related to e-transacting security, information privacy concerns, fraud, legislation problems, trust amongst participants, the actual website security, technology concerns e.g. the speed of the e-transaction and poor customer service. The employees further suggested that their concerns could be addressed through better identification methods, improved security measures, educated users, better legislation and customer service improvements. All the employees stated that identification and verification are important within Electronic Business and stated that traditional identification methods are not sufficient to address their concerns. They identified biometric verification and encrypted data transfer as their preferred means of identification within Electronic Business. The employees only had a basic biometric knowledge and expressed the need to know more about biometric identification in general and for more detailed information on the specific biometric identification method in question. Most of the employees had a positive attitude towards biometrics as a possible means of identification and felt that it could be successfully implemented in both a work and a home environment. They identified fingerprint verification as their preferred biometric identification method and felt that biometric identification would definitely reduce their concerns with regard to e-transacting on the Internet by means of additional security, better privacy protection and the building of trust amongst participants within Electronic Business. The only major concern they had that would not be addressed by biometric identification is customer service. They also mentioned that the implementation of new technology

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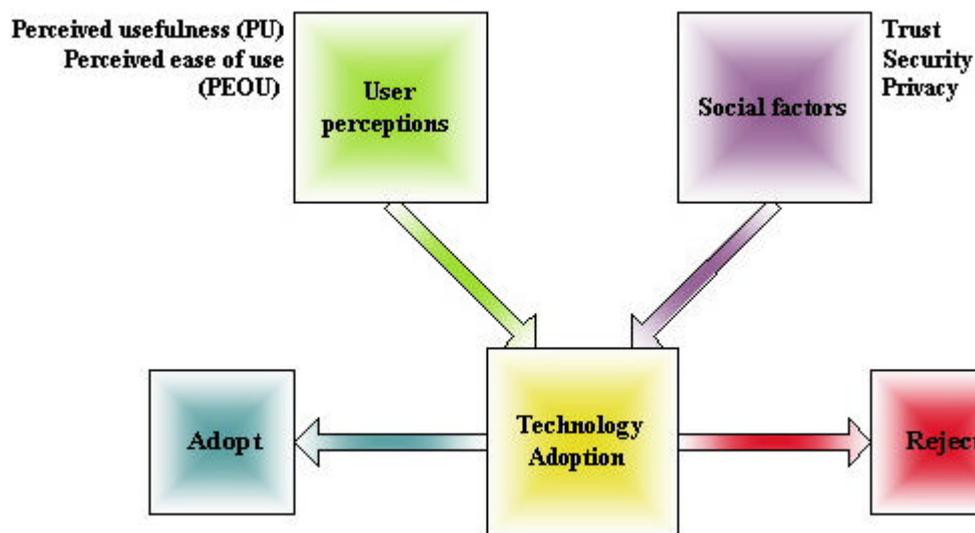
would yet again lead to new, different types of problems that would have to be addressed. However, only time would tell what these problems would be. From a user perspective the same factors would prevent/motivate individuals to adopt biometrics as an identification system e.g. a lack of information would prevent them from making use of a biometric identification system because they do not realize what it is capable of, but on the other hand, having the necessary information available to them that explains the advantages of a biometric identification system would probably motivate them to adopt a biometric identification system. From a developer/implementation perspective, the same factors would prevent/motivate organizations to adopt biometrics as an identification system e.g. their perceptions related to the ease of use of a biometrics system would prevent them from using it, but if they could see that it is in fact easy to use, it would motivate them to use a biometric identification system. It was interesting to note that the speed of the verification process is perceived by the users as being slow, but as being fast from a developer/implementation perspective. Lastly, the research results indicated that in order to achieve success with the implementation of biometrics as an identification system, issues such as user perceptions related to ease of use (user friendliness), privacy (including data security and the protection of user rights), the performance of the technology, information availability and costs need to be considered.

Chapter 9 – User perceptions related to biometrics, indicated that there is seemingly uncertainty regarding the implementation of biometrics as an identification system amongst individuals and organizations. They express the need for reassurance through phased approach pilot projects, joint efforts between participants within Electronic Business and the provision of additional information to the general public. Individuals and organizations are only interested in making use of biometrics as an identification system if it has been implemented by various organizations, in other words if it is well established in the market and has been used for a substantial period of time.

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From the results of the research study, it was concluded that the Technology Adoption Model developed for the research study would be of use in addressing user perceptions related to biometrics by adding a social factor section to the model initially developed:

Figure 10-2: Technology Adoption Model – revised



Lastly, as part of the exploratory field study section of the research study, the results from a focus group of key employees discussing the conclusions that were reached in Chapter 8 and 9 of the research study to provide more insight into the employees' perceptions and attitudes, were provided.

10.3 Research study evaluation

On completion of a research study it is appropriate to evaluate the research study to identify the contribution it has made to the discipline of Information Systems. The evaluation is done with the full knowledge that it represents only the researcher's own perspectives. This will be done by evaluating the research study objectives, the **four** essential elements that a theoretical contribution must contain as identified by Whetten (1989) and the extent to which the research questions, as identified by the process-based research framework (Roode 1993), have been successfully answered.

10.3.1 Revisiting the research study objectives

The main objectives of the research study problem, as defined in Chapter 1 – Introduction, included the identification of:

1. Important factors that influence user adoption of Electronic Business

The factors that influence user adoption of Electronic Business were identified in Chapter 3 – Electronic Business as trust amongst participants (So and Sculli 2002) and security and privacy considerations (Udo 2001). The results of the research study questionnaire identified e-transacting security, information privacy concerns, fraud, legislation problems, trust amongst participants, the actual website security, technology concerns e.g. the speed of the e-transaction and poor customer service as factors that influence user adoption of Electronic Business.

2. Why identification plays such an important role in Electronic Business

It was concluded in Chapter 4 – The importance of identification that identification is important within Electronic Business, as it will enable organizations to provide a better service to their customers and to prevent individuals from misrepresenting themselves to the organization (Clarke 1994). The results of the research study questionnaire showed that identification **and** verification are important within Electronic Business and that traditional identification methods are not sufficient. The employees identified biometric verification and encrypted data transfer as the most reliable means of identification within Electronic Business.

3. Important factors that influence user perceptions related to biometrics as an identification system within electronic business

The factors that influence user perceptions related to biometrics as an identification system within Electronic Business were identified in Chapter 5 – Biometrics as security and privacy considerations (Soutar 2002). The results of the research study questionnaire identified ease of

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use (user friendliness), privacy (including data security and the protection of user rights), the performance of the technology, information availability and costs as factors that influence user perceptions related to biometrics as an identification system within Electronic Business.

10.3.2 Revisiting the theoretical contribution process

In Chapter 1 – Introduction, it was mentioned that according to Eisenhardt (1989) a theoretical contribution, which can be considered as a trajectory or, in other words, a process (Kerssens van Drongelen 2001), is the central activity of a research study. Whetten (1989) added to this by identifying **four** essential elements that a theoretical contribution must contain. It is therefore, necessary to evaluate to what extent these **four** essential elements were included in the research study conducted.

In this study the "**what**" and "**how**" elements constitute the **subject** of the literature survey that has lead to a theoretical framework (elements (1) and (2)). These were addressed by the theoretical understanding sections found within Chapters 2, 3, 4, 5 and 6 that lead to a Technology Adoption Model for the implementation of biometrics as an identification method within Electronic Business. The links identified between the factors in the framework have been investigated through an exploratory field study (element (3)). This was addressed by distributing a questionnaire amongst eighty employees of an Information Technology organization by the name of DexIT and discussing the responses obtained within a focus group held with key employees. The results of the exploratory field study have **led to propositions** and exposed limitations in the study (element (4)). The propositions combined the ideas in the theoretical understanding sections, which led to the initial Technology Adoption Model, with the results of the exploratory field study, which resulted in a revised Technology Adoption Model.

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10.3.3 Revisiting the process-based research framework

In Chapter 1 – Introduction, various research study questions, based on the process-based research framework as identified by Roode (1993), were identified for the research study problem statement. These research study questions were formulated to provide structure to the research study and to ensure that the problem statement was approached from different perspectives. It is therefore, necessary to evaluate if these research study questions were sufficiently answered and addressed by the research study:

1. What is?

□ **What is meant by the social nature of Information Technology?**

The research question was answered by concluding, in Chapter 2, that Information Systems support and facilitate human and social processes through Information Technology and contribute towards a meaningful work life for the users within an organization. It was concluded (Roode 1993) that Information Systems are developed by people for people and are therefore, rooted within human nature (social context).

□ **What is Electronic Business?**

The research question was answered by defining Electronic Business in Chapter 3, for the purpose of the research study, as not only the buying and selling of goods and services, but also servicing customers, collaborating with business partners, and conducting e-transactions within an organization, implying both B2C and B2B environments (Turban 2002).

□ **What are the social factors within Electronic Business that impact on user adoption?**

The research question was answered by identifying, in Chapter 3, trust amongst participants (So and Sculli 2002) and security and privacy

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considerations (Udo 2001) as the social factors that could impact on the user adoption of Electronic Business.

❑ **What does biometrics comprise?**

The research question was answered by defining the term biometrics in Chapter 5, concluding that all biometric systems work in a similar way and by categorizing biometric methodologies as physiological or behavioural biometrics. User perceptions with regard to security and privacy considerations were identified as social factors that need to be addressed as part of user adoption when making use of biometrics as an identification method within Electronic Business.

❑ **What concepts do users have of what biometrics can do?**

The research question was answered in Chapter 8 by indicating that the employees only had a basic biometric knowledge and expressed the need to know more about biometric identification in general and more detailed information on the specific biometric identification method in question.

2. How does?

❑ **How do users respond to biometrics?**

The research question was answered in Chapter 8 by indicating that most of the employees had a positive attitude towards biometrics as a possible means of identification and felt that it can be successfully implemented in both a work and a home environment.

❑ **Do users respond differently to different kinds of biometrics?**

The research question was answered in Chapter 8 by indicating that the employees identified fingerprint verification as their preferred biometric identification method.

□ **How does a technology adoption process work?**

The research question was answered, in Chapter 6, by emphasizing that user adoption decisions have little to do with any supposedly innate characteristics of new innovations, but rather in specific uses of the innovation that relate to their social interactions and environment, in other words, user perceptions. Davis's (1989) technology acceptance model (TAM) focuses on user perceptions, which include perceived usefulness (PU) and perceived ease of use (PEOU), which are **two** important perceptions that guide the adoption of unknown technologies by users, as they create either a favourable or unfavourable disposition in the user toward using the innovation or not (Davis 1989). Davis (1989) postulates that individual perceptions about "**how-useful-is-this-for-me?**" and "**how-easy-is-it-to-use?**" are **two** important perceptions that influence the adoption of technology and will eventually lead to an adoption or rejection decision by the individual evaluating the innovation.

3. Why is?

□ **Why is identification so important in Electronic Business?**

The research question was answered, in Chapter 4, by concluding that identification was always social rather than economical in nature, but as the complexity of economic transactions developed the need arose for accurate identification (Clarke 1994). On-line credit card fraud was used as a practical example to illustrate the importance of accurate identification in Electronic Business.

□ **Why do users respond to biometrics in the way they do?**

This research question was answered in Chapter 8 by indicating that the employees felt that biometric identification would definitely reduce their concerns with regard to e-transacting on the Internet by means of

additional security, better privacy protection and the building of trust amongst participants within Electronic Business.

□ **Why would users adopt biometrics?**

This research question was answered in Chapter 8 by indicating that the same factors would prevent/motivate individuals and organizations to adopt biometrics as an identification system. Lastly, the results of the research indicated that in order to achieve success with the implementation of biometrics as an identification system, issues such as user perceptions related to ease of use (user friendliness), privacy (including data security and the protection of user rights), the performance of the technology, information availability and costs needs to be considered.

4. How should?

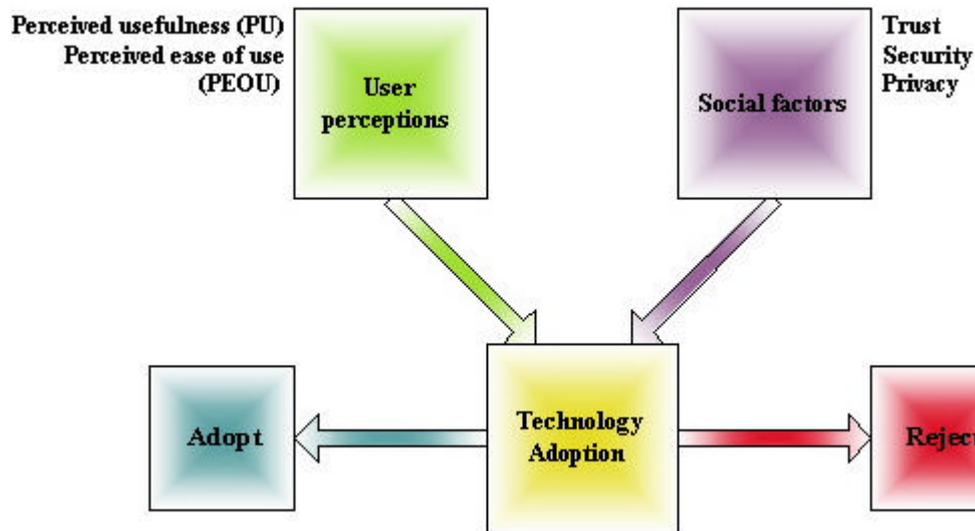
□ **How user perceptions, related to biometrics, should be taken into consideration to ensure success with the implementation of identification through biometrics in Electronic Business?**

This research question was answered in Chapter 9 by indicating that there is uncertainty amongst individuals and organizations regarding the implementation of biometrics as an identification system. The employees expressed the need for reassurance through phased approach pilot projects, joint efforts between participants within Electronic Business and the provision of additional information to the general public. Individuals and organizations are only interested in starting to make use of biometrics as an identification system if it has been implemented by various organizations i.e. if it is well established in the market and has been used for a substantial period of time. The employees indicated that perceived usefulness (PU) and perceived ease of use (PEOU) would definitely play a role in their adoption of biometrics as an identification system, they also had certain social

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factor concerns, which include e-transacting security and/or fraud, information privacy, and trust amongst participants within Electronic Business. This last statement lead to the compilation of a Technology Adoption Model for the research study problem statement:

Figure 10-3: Technology Adoption Model – revised



10.4 Future research studies

“New ideas are always criticized – not because an idea lacks merit, but because it might turn out to be workable, which would threaten the reputations of many people whose opinions conflict with it.”

Unknown

While researching the research study problem statement, additional areas were identified that could be used for future research studies in the Information Systems field. These include cultural barriers, encrypted data transfer and digital certification, legal aspects and implications, and the biometric identification implementation process.

10.4.1 Cultural barriers

Cultural barriers have been identified as a possible aspect for a future research study as they are complicated to resolve (ArticSoft 2003) e.g. in one country it could be culturally unacceptable to look another individual in the eye, which would definitely have an impact on user perceptions regarding biometrics as an identification method if retina scanning or iris scanning is going to be used as the preferred biometric identification method. Human action is a process in which users continuously make use of all the material, intellectual and cultural instruments at their disposal, in combination with the perceived opportunities and constraints of the situation. Culture sets values, norms and limits; it is a way of thinking that determines behaviours, decisions-making process, actions and knowledge (Demeester 1999). It is an abstract concept that represents the most unconscious value system that users utilize to deal with other individuals, the community, authority and the world (Demeester 1999). According to Demeester (1999) culture manifests itself through behaviours, in decisions and through actions as a component of a problem solving approach. When individuals are confronted with a new situation, their first reaction is oriented by their cultural structure (Demeester 1999). Culturally, one size does not fit all, and that may increase the cost and complexity of solutions (Demeester 1999). Shankar *et al.* (2002) states that organizations need to be culturally sensitive and that cross-cultural differences may even be more important in Electronic Business than normal commerce. Although Electronic Commerce removes physical barriers, psychological barriers are still not eliminated.

Possible future research study questions could include:

1. What do cultural barriers mean?
2. Do users respond differently to biometrics based on their cultural beliefs?
3. How should cultural barriers be addressed?
4. Why is it important to understand the possible impact of cultural barriers on new innovations?

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10.4.2 Encrypted data transfer and digital certification

Encrypted data transfer and digital certification have been selected as aspects that could be included in a future research study, as the results of the research study questionnaire indicated that biometric identification methods need to be combined with encrypted data transfer and digital certification in order to improve the security within Electronic Business. A digital certification process comprises a digital certificate and can be defined as a statement signed by an independent and trusted third party. The statement usually follows a specific format (Thawte 2003). A digital certificate is the electronic counterpart of driver's licenses, ID documents, passports, memberships cards, etc. and is used to electronically prove an individual's identify or the individual's right to access certain information or service on-line (British telecommunications 2002).

A few well-known uses for digital certificates as summarized by the British telecommunications (2002) include:

1. When an individual receives digitally signed messages, he/she can verify the signer's digital certificate to determine that no forgery or false representation has occurred.
2. When an individual sends messages, he/she can sign the messages and enclose a digital certificate to assure the recipient of the message that the message was actually sent by the individual.
3. An individual can use a digital certificate to identify him/herself to secure servers such as membership-based web servers.
4. Generally, once an individual has obtained a digital certificate, he/she can set up a security-enhanced web or e-mail application to use the digital certificate automatically.

Virtual shopping centres, e-banking and other electronic services are becoming more commonplace, offering the convenience and flexibility of round-the-clock service direct from an individual's home. However, concerns

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about privacy and security might be preventing individuals from taking advantage of this new medium for personal business. Biometric identification methods, encryption data transfer and digital certificates alone are not enough, but combining the methods will possibly address these problems, providing an electronic means of verifying an individual's identity. It can provide a more complete security solution, assuring the identity of all parties involved in an e-transaction and will therefore, form a sound base for a future research study.

Possible future research study questions could include:

1. What do encrypted data transfer and digital certificates mean?
2. How do users respond to encrypted data transfer and digital certificates?
3. Why is it important to combine encrypted data transfer and digital certificates with biometric identification methods?

10.4.3 Legal aspects and implications

Legal aspects and implications have been selected as a future research study subject because:

1. The use of biometrics as an identification method has prompted privacy issues that need legislation (Albrecht 2003).
2. Traditional knowledge-based identification methods have one decisive disadvantage; they cannot actually prove the authorization of the acting party (Albrecht 2003).
3. Biometric identification systems make use of a user's physiology to weed out impostors; this has prompted some privacy issues, which requires legislation (Bequai 1996).

Upon closer examination, even the legal status of a biometric method depends on its application e.g. whether it can be traced back to the right individual, through a good deal of effort (Grijpink 2001). Prins (1998) states that the introduction of biometric identification methods requires the government to make conscious choices regarding its policies. So, in what respect does the use of biometric technology challenge the law (Prins 1998)?

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1. **Biometric technology and fundamental rights** – it could be argued that the use of unique characteristics of an individual such as his or her fingerprint, iris or hand geometry, limits certain individual liberties, as enacted in most national constitutions and in international basic documents on human rights.
2. **Biometric technology and personal data protection** – it could be argued that the use of biometric data and the means of storing these data are subject to relevant laws.
3. **Biometric technology and security conditions** – it could be argued that the demands posed on security are not stringent enough to necessitate biometric technology.
4. **Biometric technology and evidential issues** – what procedures exist for individuals that wish to challenge adverse decisions based on biometric measures?

Prins (1998) concludes by stating that the government needs to create a context in which the introduction and application of biometric technology can be critically developed. If not, the marketplace and societal interest will, to a large extent, determine the developments, which could pose adverse affects for individuals' interests and rights. The employees that participated in the questionnaire indicated that biometric data needed to be kept secure and private, with full legal recourse against offending parties.

The second reason for selecting legal aspects and implications looks at the positive side of biometrics as an identification method. The use of a PIN or password can only assess whether the code used is correct – a PIN or password cannot make a personal verification and this is where biometric identification methods can distinctly improve a security model (Albrecht 2003). This assessable proof of authorization will become more important as Electronic Commerce progresses (Albrecht 2003). In the virtual world in which the contractual party cannot be visually or acoustically perceived and is

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recognized only as text on a computer screen, the verification of the communication partner becomes quite consequential (Albrecht 2003). The success of business transactions in the digital world is therefore, decisively dependent upon the trustworthiness of the technical means employed, and according to Albrecht (2003), biometrics as an identification method can offer what is needed in a digital world.

Possible future research study questions could include:

1. What is meant by legal aspects and implications with regard to biometric identification methods?
2. How do the legal aspects and implications differ between the implementation of a biometric identification system in a digital and non-digital world.
3. How should legal aspects and implications be addressed with the implementation of biometric identification methods?

10.4.4 Biometric identification implementation process

The biometric identification implementation process has been selected as an aspect that could be included in a future research study, as the results of the research study questionnaire showed that the employees need more information on biometric identification systems before they would be prepared to start using them. This means that organizations wishing to implement a biometric identification system would have to be aware of the information needs of the employees to ensure a successful implementation process. The results of the research study listed the following information needs: background information on biometrics in general, advantages and disadvantages of the specific biometric identification method, a user guide on the use of the biometric identification method, results from comparable sites, users and case studies conducted, database information – where the biometric data is stored, the security of the system storing the biometric data, the security of the path getting it to the database and who has access to the biometric

database, support service and maintenance available as part of the biometric identification system and future improvements and enhancements planned for biometric identification methods. Possible future research study questions could include:

1. What is meant by an implementation process?
2. Of what does an implementation process comprise?
3. How does an implementation process work?
4. How should an implementation process with regard to biometric identification methods be addressed?
5. Why is an implementation process important?