Issues Affecting the Implementation of Multiple Application Smart Card Systems

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Abstract

This paper describes the results of a study into the use of multi-function smart cards in the university environment, an area in which they have been widely deployed and quite successful. Traditionally, smart cards have tended to handle a single application, rather than being linked to a number of applications. The variety of facilities and services available on a university campus which can be placed on a smart card, however, have made it a promising arena in which to introduce integrated systems (and hence to investigate the integration of these functions). This paper describes results from the first round of a Delphi study focused on investigating the issues associated with success or failure of smart card systems in the tertiary sector. The survey round results show that the issues universities and solution providers consider to be important cover a wide range, including: procedural/operational issues, technical issues affecting the efficiency and reliability of a system, and social issues affecting the users of the system.

Introduction: Smart Card Applications

Smart Card technology offers users a secure and convenient way of performing an array of activities, often payment or identification related. Because they can store and protect relatively large amounts of data, smart cards have been proposed for a variety of purposes around the world. Despite wide enthusiasm for the technology, however, many smart card projects have failed to take off as expected; particularly those associated with monetary functions. High profile applications such as the use of stored value cards at the Atlanta Olympics, or in e-cash pilots such as the Citibank trial in New York, have brought either failure or mixed success. Faith in the technology remains strong, however, as witnessed by American Express' launch of the "Blue" credit card, and Visa's Smart Credit card. These initiatives are being driven, at least in part, by the offer of secure transactions and authentication of sales over the internet – a potentially huge market. So is the smart card in eCommerce a technology which has been looking for the right

business case(s), such as internet authentication, or have unsuccessful systems failed for other reasons? One way to shed light onto the promising potential uses of smart cards in this environment is to look at the characteristics of successful smart card systems in other fields.

Since the first smart card system was introduced by Moreno in 1974, thousands of smart card based systems have emerged. A smart card market forecast described in Kaplan (1992) suggested that 3800 million smart cards would be in use by the year 2000. The potential of smart cards lies in their versatility. Smart cards can be used for various applications, including access control/security, entertainment and leisure, access to financial services, health care services (particularly the storing of health care records), retail/utilities, transport, telecommunications, and as a "wallet" for storing electronic cash.

As the number of useful applications for smart cards has increased, the number of disparate applications being developed has shown at least equal growth rates. Multi-function cards are still quite rare, however, and the number of applications integrated within a single card has been fairly small. There is, however, one domain which has been active in pursuing multi-application (or multi-function) cards. The University sector, because of the encapsulated nature of student life on campus, has led the way in exploring and testing the limits of multi-function smart cards. Students currently have to hold separate cards for functions such as: Photo ID, photocopying, storing meal vouchers, gaining access to security doors or bank accounts, and telephone use. One integrated system could combine all these functions onto a single card – and Universities thus provide an excellent environment for the introduction of a multi-function card.

Research Design and Objectives

Although there have been numerous studies conducted on the implementation and application of smart cards, most have been focused on the areas of privacy, security and data storage on smart cards (eg Lokan, 1991; Farroukh and Hornung, 1995; Burke, 1996; Evans 1996; Smart Card Forum News, 1996; Smart Cards, 1997). These few topics have been examined across a variety of sectors: cases include access control and security in the health care sector (ISCIG, 1996, Farroukh and Hornung, 1995), internal passports for trainee pilots – for instance the airbus industry (TISCIG, 1997), in pedestrian area access control – for example the Singaporean armed forces, (TISCIG, 1997) and financial applications (Plunkett, 1966; Worthington, 1996; Arnavutian, 1997; Birch, 1997; Everett, 1997). One of the few Australian studies available was completed by Lindley (1996), who identified acceptance criteria for Australian smart card users, and consequent design objectives for smart card systems.

While these are unquestionably valuable and useful areas for study, we were interested in focusing on a slightly different target group – in order to investigate which issues might affect the success or failure of integrated, multiple-application systems. Rather than focus on user issues and the impact of smart cards as a technology, as most studies have done, we were interested in understanding the views and opinions of the two parties with the most extensive knowledge of the systems development and implementation process: the university representatives, and the solution providers themselves. We also sought the views of a smaller number of student "users", but only to provide some corroboration of our findings – we wanted to ensure no key issues were missed when presenting issues to the experts for consideration, but

the users were not themselves the focus of the study[1].

Choice of Method: the Delphi Study

As reported in an earlier CollECTeR paper (Welikala *et al*, 1997) which described the preliminary objectives and designs of the research, we selected the Delphi study as our research mechanism. In deciding on an appropriate research method, we were influenced by two major considerations:

1. there is a lack of documented research on smart card implementations, particularly in terms of their applicability to the university sector. The lack of established models or theories on which to build, or to test, meant that the research was most appropriately aimed at theory generation;
2. although no Australian University has successfully implemented a smart card scheme, such implementations were quite commonplace overseas. To draw on this body of knowledge, we needed a method which would allow us access to international participants. Case/survey research of local organisations was neither possible nor sufficient.

For these reasons, we decided to adopt a variant of the Delphi survey approach. Delphi is a technique which uses written responses rather than bringing individuals together. It does not require face-to-face contact, but provides a useful combination of expert knowledge from people such as experts in the research area or users in the research area who cannot physically come together (Delbecq *et al*, 1975). It is particularly useful when accurate information is unavailable or expensive to obtain, or where evaluation models require subjective inputs to the point where these become the dominating parameters (Linstone and Turoff, 1975).

We decided a Delphi survey would allow us to gather a wide variety of expert opinion on existing smart card introductions within the tertiary teaching sector overseas, so that we could obtain consensus on the issues relevant to introducing smart cards to the Australian university sector (or other possibly suitable environments). Administering the survey via email allowed us access to a much wider sample group than would otherwise have been possible, and made it possible for us to obtain reliable opinion from a group of experts.

Selecting an Expert Population

Delbecq *et al*. (1975) argued that the participants in a Delphi are individuals who have a deep interest in the issue under investigation; and important knowledge or experience that can be valuable for the study. We selected as our survey sample, therefore, individuals considered to be experts (actual implementers of multi-purpose and multi-function ID cards). We began by compiling a list of universities and vendors who had participated in smart card schemes. We

[1] The student user group should not, therefore, be considered representative of the expert user group – since they are both non-experts in terms of system implementation, and are included in the study in numbers too small to be statistically meaningful.

found 144 in total (101 Universities, 37 Solution Providers and 6 individual users of student smart card schemes) from 16 different countries. We then invited these individuals or organisations to participate in the survey. The review and some initial responses indicated that, for a number of reasons, some universities had decided to introduce the Magnetic ID Card in place of Smart ID cards. For this reason, we included individuals and organisations (Universities, Solution Providers and Users) with knowledge and experience in Magnetic ID Card and/or Smart ID cards.

Our objective in using a Delphi survey was to capture qualitative data, not to use the data for statistical purposes. Purely quantitative research seemed inappropriate, for:
"when [quantitative] methods are used to investigate research topics about which theoretical development is scant or uncertain, research often is inefficient or misleading. Either the power of deductive methods is under-utilised, or theory and/or method are prematurely pressed into service when their underlying assumptions cannot be met" (Bonoma, 1985, p.201).

Investigating Smart Card Implementation Issues

The objective of the first survey round was to take what issues could be identified in the literature as relevant to multifunction smart card systems, and present this information to the expert body for their view. The objective was to validate the literature we had found, and to identify missing issues not raised in the literature but considered relevant by practitioners.

Once we had decided on the Delphi technique as our research methodology, we considered the following design decisions:

- Success of a Delphi survey, as with any survey, depends on the number of participants involved in the project. A higher number of participants will produce better results. The first round survey was targeted at 15 - 20 universities, 5 - 10 solution providers and 5 - 10 student users with the hope that the number of responses would be between 30 - 40 in total.
- A second round questionnaire was sent only to those respondents who had participated in the first round. The maximum number of responses to the second round would be equivalent to the number of responses to the first round. To expect a 100 percent response rate was not realistic, but more than 50 percent seemed achievable. We therefore targeted 50 percent of the participants in the first round as a minimum second round participation number
- Electronic mail was used to communicate with participants
- Since time was a limiting factor (one year), we decided on two rounds of Delphi survey
- Structured questions would be used for the first round questionnaire to allow participants to provide analysable data on what we realised could be a large body of information
- More open-ended (less structured) questions would be used for the second round questionnaire, to allow us to obtain more descriptive opinions on success factors associated with introducing a smart card system.

From this analysis of the literature, the first round questionnaire was developed. The relationship between the literature analysis and the first survey round is shown in Figure 1.

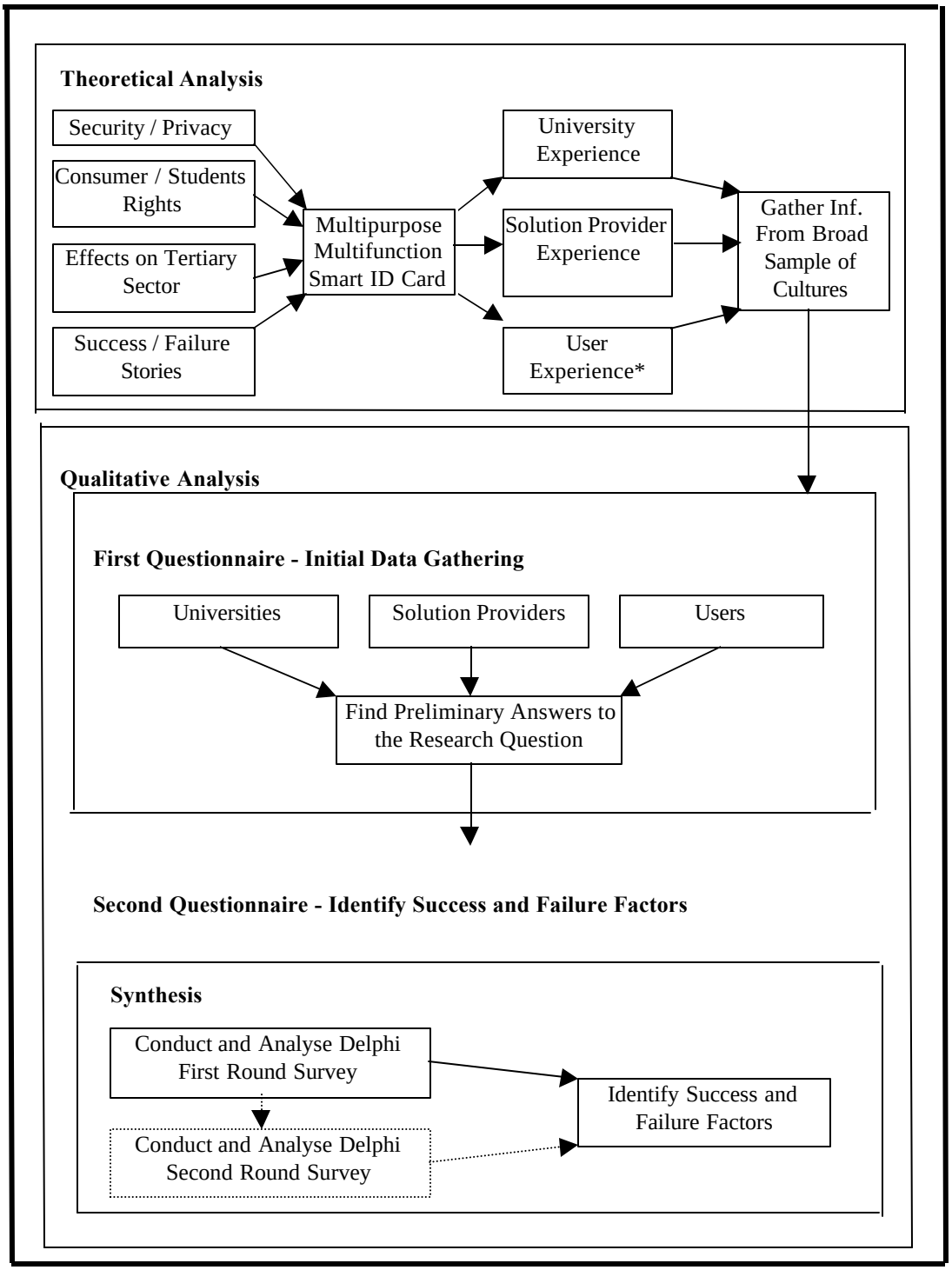

Figure 1 : The Structure of the Research Project

The goal of the first round questionnaire was to identify how different universities and solution providers have implemented ID card systems, from a variety of campuses across as broad a sample of countries possible. This would provide information regarding the process associated with university smart card implementations.

The sample chosen was a set of different types of participants:

Universities

We considered a minimum of three months' experience in the implementation of smart card systems would be sufficient for a university implementer to have gained sufficient knowledge of the issues (theoretical and practical) associated with smart card implementation to participate usefully in the survey. We included in the sample universities using magnetic stripe cards as multi-function ID cards. Although these cards do not contain a "smart" chip, they provide the same functionality – and the literature suggested a majority of universities might be using such cards.

Solution Providers

As we were focused on investigating issues associated with a certain environment (the university campus), we decided not to consider those solution providers supplying multipurpose, multifunction smart card solutions to non-university sector organisations. We set a major criterion for selecting a solution provider to be their experience with at least one university installation.

Users

The major focus of our study was to identify success and failure factors from the people involved with systems implementation. This narrowing of target group was chosen because the extant Australian pilots had failed in their early stages, suggesting difficulties associated with creating the systems, rather than failure due to non-use. For this reason, and because of the logistical difficulties associated with contacting a sufficiently representative number of students from overseas to investigate user perceptions fully, a strongly developer/implementer focus was taken. We chose to solicit some feedback from students of a single system, however, as a secondary information source, to see if the responses in terms of perceived success and issues varied greatly from the impressions of the universities.

Table 1: The Initial Sample – Separated By Country.

	Continent	**Country**	**No. of Universities**	**No. of Sol. Providers**	**No. of Users**
1	Australia	Australia		2	
2		New Zealand	3		
3	Asia	China	1		
4		Hong Kong	2		
5		Japan	3		
6		Malaysia	1		
7		Singapore	2	1	
8	Europe	Austria	1		
9		Denmark	2		
10		France		1	
11		German	3	1	
12		Greece	3		
13		Hungary	1		
14		Netherlands	5	1	1
15		Norvey	2		
16		Spain	3		
17		U.K.	5	1	1

	Continent	Country	No. of Universities	No. of Sol. Providers	No. of Users
18	America	Canada	6		
19		Mexico		1	
20		U.S.A.	69	18	11
21		Venezuela	1		
22	Africa	Israel	1	1	
			114	27	13
	Countries		**19**	**9**	**3**

The first questionnaire was composed of closed, specific questions about the project with which the participants were involved. The main strategy of this round was to identify how respondents had implemented their ID card system, and to identify their perceptions.

We prepared three questionnaires for the targeted groups. 90 percent of the questions were limited to "Yes" or "No", or to short answers. These measures were designed to maximise the chances of response.

The questionnaire prepared for the universities contained 91 questions under 21 headings:

The University
The Card
The Project
Banking Features
Electronic Purse
Student Accounts (Cash deposits) maintained by the University
The Uni. Financial Aid Program
Facilities
Telephone Company
Special Features
Comments
Financial
Pilot Project
Implementation
Vendors
Advantages
Disaster Recovery Plan
Post Implementation Review
Expected Changes / Enhancements
Other Successful University Id Projects
Your Involvement

A similar questionnaire was sent to solution providers, containing 68 questions under 17 headings. The primary difference was that this questionnaire focused more specifically on development issues, to match the solution providers' area of expertise:

Provider
Background of the Company
Products (University Id)
Facilities
Special Features
Pilot Project
Implementation
Advantages
Post Implementation Review
Disaster Recovery Plan
Expected Changes / Enhancements
Other Successful University Id Projects
Joint Ventures
Other Smart Card Projects

Clients
Information
Comments

The questionnaire sent to the student users contained 35 questions under 7 headings:

User
Background of the University
Facilities
Advantages / Benefits
Problems
Conditions / Limitations
Comments

After draft versions of the questionnaires had been developed and revised, the questionnaire was piloted with the executive manager of technology development, Card Services Division, at a large Australian bank with smart card implementation experience. The tested and revised questionnaire was then sent out via email to the participants.

By analysing the first round responses we derived a list of possible success and failure factors. In the second round questionnaire we asked the participants (respondents to the first round only) to rank the list of success and failure factors from their experience, and to add further issues prompted by the feedback received from the first round. The results of the second round survey, which was much more subjective in nature, are not presented in this paper.

Results of Round One

The first questionnaire was composed of closed, specific questions about the project with which the participants were involved.

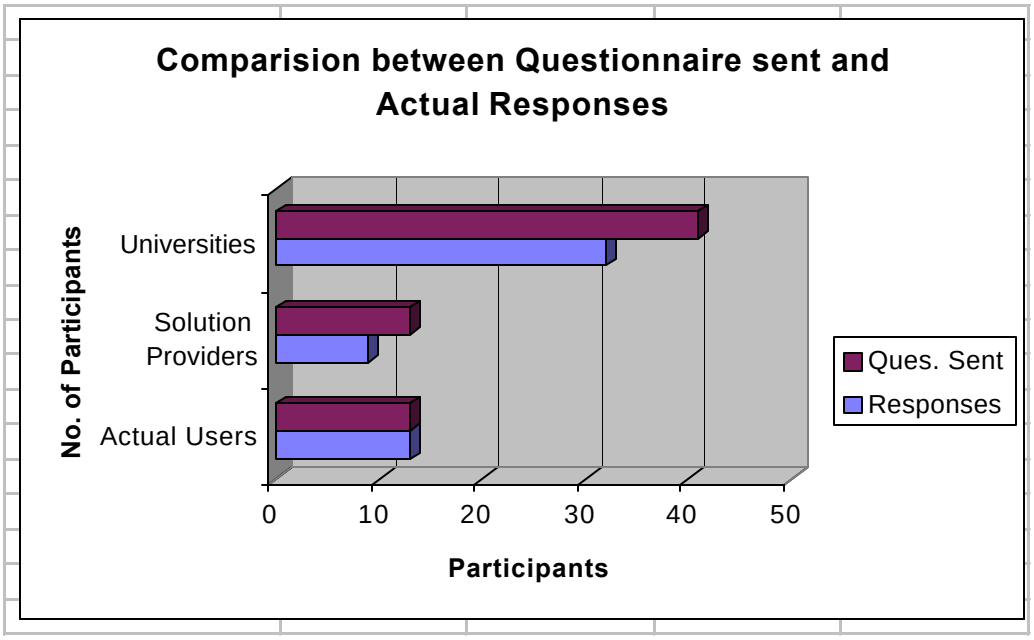

Figure 2 : Questionnaires sent and number of Responses

32 universities in 10 countries, 9 solution providers in 7 countries and 13 card users in 3 countries participated in the survey. Figure 2 shows the comparison between questionnaires sent and the actual responses received.

Table 3 shows the distribution of the participants in the 1st round survey

Table 3: 1st round survey participant distribution

	Continent	Country	No. of Uni.s	No. of Sol. Pro.	No. of Users
1	Australia	Australia		1	
2		New Zealand	3		
3	Asia	Japan	1		
4		Malaysia	1		
5		Singapore	2	1	
6	Europe	France		1	
7		German	2	1	
8		Netherlands	2		1
9		U.K.	3		1
10	America	Canada	4		
11		Mexico		1	
12		U.S.A.	13	4	11
13		Venezuela	1		
14	Africa	Israel		1	
			32	9	13
	Countries		**10**	**6**	**3**

Characteristics of University Smart Card Systems

The first questionnaire was composed of closed, specific questions about the project with which the participants were involved. The main strategy of this round was to identify how respondents had implemented their ID card system, and to identify major issues: we were seeking to discover the features and benefits most used/coveted by those universities which had implemented smart card systems.

Three questionnaires were prepared for the targeted groups. 90 percent of the questions were limited to “Yes“ or “No“, or to short answers. These measures were designed to maximise the chances of response.

The questionnaire was piloted at the Card Services Division of a large Australian bank, after which the tested and revised questionnaire was sent out. The following table shows the ways in which the systems were being used.

Table 4: Summary of University Smart Card System Uses

THE CARD

The primary objective of the universities which responded was to use the card as a multipurpose, multifunction student identification card. Every university responding used the card as a student identification card, irrespective of its other uses.

- Every university had a minimum of 3 functions tied to its card (max was 15; average 8)
- The most commonly used functions, in addition to student identification, were: meal plans; electronic purse; and access control to facilities such as parking or building access.
- 18 of 32 schemes used a magnetic stripe card. 10 used a chip and stripe; only 3 were chip only
- 20 of 32 cards were used as library cards
- the cards were used to store static, value, historical, and company data
- In most cases (24 out of the 32 schemes), the university owned the student identification card. One scheme was owned by a bank, while three schemes were owned by a third party
- 18 out of the 32 schemes used the ISO standard in their student identification card. Seven schemes don't comply with an ISO standard and the rest didn't answer this question.

THE PROJECTS

All projects commenced somewhere between Jan 1991 and Sept 1997. The maximum annual growth rate varied from 900 to 30,000 users, in the case of one US university which had not yet reached full deployment levels.

BANKING FEATURES

The banking facilities reported by most respondents were not particularly sophisticated. Of the 32 schemes, 10 were connected with a bank, the remainder were not, and only 3 out of these 10 schemes had the facility to link multiple bank accounts. 3 out of the 10 schemes were connected to a bank other than the university's official bank; only one had the facility to link multiple bank accounts from different banks (to the one card. 6 out of the 10 schemes allowed users to change banks. A common limitation amongst schemes was that the bank account could only be used for purchases over $ 10.00.

ELECTRONIC PURSE

Electronic purse facilities, or ecash, was a more widely used feature in the systems reported. 25 out of the 32 schemes had an electronic purse facility. Two of the university schemes even maintained two purses on the same card. Protection of the purse with a PIN, suggested as an important issue by the literature, was quite variable. 7 out of the 25 schemes protected the purse with a PIN number; 12 schemes are not protected by a PIN (the rest didn't answer this question). 9 out of 25 schemes had a maximum deposit amount on the purse.

STUDENT ACCOUNTS (CASH DEPOSITS) MAINTAINED BY THE UNIVERSITY

Some of the universities maintain student accounts, as though they were banks, to allow students to make deposits. These deposits can then be used to make any purchase (stationary, food, pay tuition fees) within the university. Although this seems to be a common practice, especially in American universities (12 / 32 responding universities maintain student cash accounts), only five of these schemes were linked with the smart card of the university.

FINANCIAL AID PROGRAMS

8 / 32 schemes had ties to the university's financial aid program, allowing students to receive periodic payments of their grants.

OTHER FACILITIES

There are many other facilities which can be linked, such as transactions with vending machines, meal plans in student cafeterias, identification (university activities, library, access to security doors, parking, health service), access for student records (transcript of academic records, address change, forward graduation application) and transactions with on- and off- campus shops. From the responses received from the universities:

- 25 out of the 32 schemes offered the opportunity to make transactions with machines (vending machine, laundry, photocopier, printer). The most popular choices were photocopiers and vending machines
- some schemes give the student the opportunity to purchase a ticket for either public or private buses via the card. Discount transport tickets are another facility often tied to the card

TELEPHONE COMPANY

10 / 32 schemes were linked to the services of a telephone company. The common benefit of these schemes is that students have the facility to get calls at a discounted rate. Students using these schemes must be linked with the

university's official telephone company. In four out of the 10 schemes the university had the right to change the telephone company, if it was not happy with the service.

The most common limitation on telephone services for local calls, was the available balance in the electronic purse; that is, a maximum amount could be deposited onto the card (like a phonecard). The most common limitation on telephone services for long distance calls, was a pre-defined credit limit such as $150.

SPECIAL FEATURES

Some of the cards were linked with additional special features, such as cost centres or maintaining multiple accounts. These are particularly useful to a university where, for instance, cost codes are allocated to particular services, such as photocopying. 7 / 32 schemes incorporated a multiple accounts feature into the student ID card project.

PILOT PROJECTS

The literature technology transfer literature typically stresses the importance of completing a pilot project. Only one quarter of the schemes (8 / 32) conducted a pilot project before implementing the student ID card project in full, although 2 out of these 8 schemes actually conducted three pilot projects. The duration of the pilot projects varied from 1.5 months to 30 months.

IMPLEMENTATION

The minimum time taken to implement the system was three months (with 15 facilities on the card), and the maximum time taken was six years (a card project incorporating 9 facilities). The number of phases in the implementation varied from two to six. The most common approach was to implement in three stages.

VENDORS

Universities apparently saw flexibility in vendor choice as being important, as 21 / 32 schemes provided the opportunity to change vendor when required, whereas only 4 were locked into the one vendor.

ADVANTAGES TO STUDENTS

The advantages to the students, from the university point of view, fell primarily into four groups: safety, convenience, no need to use cash, and multi-functionality. 50 percent of respondents said that students had taken the new multifunction, multipurpose ID card in good faith.

DISASTER RECOVERY

11 out of 32 schemes had a properly defined disaster recovery plan. Regardless of whether or not each university has a disaster recovery plan, all had the capability of performing all the operations of the card system manually. In many projects the reading devices (eg: Access to security doors in labs, Halls of Residence) for the cards were not linked with the central database. Data necessary to identify the card holder was stored in the card itself. Therefore central database failure would not affect such applications.

PROJECT MOTIVATIONS

16 out of 32 schemes regarded the project as a student service; 4 schemes made sufficient earnings to cover expenses (breakeven); 6 schemes gained profits from the project and the rest were a combination of the above.

One explanation of why a mag strip card was chosen over smart cards, was that the expense of the smart card was prohibitive ($4-$10 per card depending on memory size of chip), that the durability and security of the chip were questionable, and that US smart card standards were not in place at the time of adoption.

POST IMPLEMENTATION MAINTENANCE/ ENHANCEMENTS

The combined intended enhancements over the next five years amongst the university systems are:

- To charge for services provided.
- Add new facilities - Internal.
- Add new facilities - External.
- Add new facilities - Bank, Telephone Company.
- Move to a Smart Card from a Magnetic Stripe Card.
- Introduce ISO standard.
- Redesign the card.
- System Upgrade.

Upgrade Equipment.

While the types of functions found across the different systems were quite consistent, the replies from implementers regarding problems encountered or obstacles to overcome was more diverse.

The concerns of the universities were spread across both operational and strategic issues and concerned relationships with suppliers, students and staff, as well as companies/organisations participating in the system, and technical issues to do with hardware. The result of these problems ranged from delays in achieving predefined objectives such as anticipated profits, to the duration of the project to completion.

There was considerable diversity in the amount of experience the different solution providers had. The number of university ID card projects implemented by the different solution providers varied from 1 to 387. The number of university ID card projects in different countries (6 countries across North America and Europe) implemented by the different solution providers varied from 1 to 20. This suggests that as the market for smart card technologies increases, the number of new smart card solution providers may be increasing. If experience is a success factor (or lack of experience a failure factor), then an increasing mix of newer vendors compared with those with significant experience may impact future projects. The programming languages used in the systems varied, with Assembler, C, C++, FORTH, Dbase and Btrive, as well as proprietary languages, being used.

End Result: Potential Success and Failure Factors Identified

In comparing the results of the first round questionnaire, a set of combined success and failure indicators were generated from the points of view of the university, user and solution provider. Analysis of these first round data revealed a list of possible effectiveness indicators for smart card implementation in a university environment. The tables below show the success and failure factors suggested by the first round results, derived for each respondent group.

Success and Failure Factors for Universities

Many of the identified indicators, both success and failure, were common across universities. From these indicators we compiled a preliminary list of success and failure factors to test in the second round of the Delphi survey. The second questionnaire for the university group contained a list of 18 success factors and 5 failure factors for the respondents to rank.

Table 5: Possible Smart Card Success Factors for Universities

POSSIBLE SUCCESS FACTORS FOR UNIVERSITIES
VERSATILITY OF CARDS (the types of functions supported on the Chip, Magnetic Stripe or Contactless card). There are different types of ID cards in different universities, including magnetic stripe card, smart card, contactless card, combination of above, multiple chip card. Different types of cards gave different types of versatility to the user.
NUMBER OF PARTICIPANTS IN THE SCHEME (SIZE OF INITIAL OFFERING) AND RATE OF GROWTH. The existence of an ID project depends on the number of participants and the anticipated growth rate. According to the responses to the first questionnaire, universities with larger student populations have tended to tie many facilities to the ID card, while universities with smaller student populations have linked a more limited number of facilities (see Table 6.7 in Appendix 6). Trying to ascertain a general rule as to necessary or desirable growth rate is an important issue for budgeting purposes.
LIMITED BANK ACCESS - STUDENTS RESTRICTED TO A SINGLE BANK. • the multifunction ID card systems identified can be linked either to a single bank or multiple banks. If the university is linked with a predefined single bank it may help the university to make additional income from the bank to cover expenses. One respondent mentioned that 80 percent of its earnings are

POSSIBLE SUCCESS FACTORS FOR UNIVERSITIES

gained from its bank.

The annual revenue of the Mcard is US$ 3 billion. So far the university has issued 65,000 ID cards and 18,000 cards are linked with the bank which has US$ 22,000 million (Russell, Card Australia 97 - AIC Conference, Melbourne, August 1997).

UNLIMITED BANK ACCESS - STUDENTS CAN ACCESS ANY BANK (MAXIMISING STUDENT CHOICE).

If the system can be linked to multiple banks (ie there is no restriction on the banking feature), students have the opportunity to gain access to any bank or banks they wish. This issue was included to gather impressions as to whether maximising student choice might be a success factor.

CLOSED SYSTEM SCOPE - STUDENTS CANNOT USE CARD OUTSIDE INSTITUTION (MAXIMUM UNIVERSITY CONTROL).

If a multifunction ID card system is implemented in a university without participation of third party organisations such as banks, telephone companies and external vendors, the university has more control over the project.

OPEN SYSTEM SCOPE – STUDENTS CAN USE CARD OUTSIDE INSTITUTION (MORE FLEXIBILITY TO THE USER).

Conversely, if a system is implemented in a university which includes participating third party organisations such as the bank, telephone company and external vendors, the university has less control over the project but the project will give more flexibility to the user.

PROFITABLE RELATIONSHIP WITH BANK (UNIVERSITY COMMISSION).

Given that (as mentioned above) one respondent cited that 80 percent of their earnings are gained from commissions from the bank, it seemed such relationships may be a success factor for a university smart card system. The university can also benefit from the following revenue opportunities with the bank:

- Interest on account balances.
- Royalty payment from the bank (Depending on the number of accounts).
- Revenue from ATM use.
- Commissions from point of sale.

TELEPHONE – PHONE CARD FACILITIES.

"Many of our students do not have their own phone or move frequently and the phone number changes."

MULTIPLE PHONE SERVICE SELECTED FACILITIES (EG CALLING CARD, DIRECT DIAL, VOICE MAIL): EXTRA FUNCTIONALITY.

The literature survey revealed that some university ID cards linked with a telephone company, which provides many additional associated services such as Calling Card, Direct Dial, Voice Mail. This impact of offering such functionality seemed worth including for comment from the respondents.

ABILITY TO CREATE/SUPPORT SEPARATE COST CENTRES.

The cost centre concept is potentially an important feature in any project. A Department could keep different machines which are linked to the electronic purse feature such as photocopier, fax machine as cost centres. According to the first round survey 13 out of the 32 schemes incorporate the cost centre feature in the student ID card project.

CARD ALLOWS FOR AUDIT TRAILS.

In the first round Delphi survey universities as well as actual users mentioned that they were afraid of using the electronic purse, that they feared that the amount stored in the electronic purse may disappear or the amount stored in the electronic purse may not be correct. This especially applied to non-technical or first time users. In addition to helping students to keep track of their expenses, an audit trail may help alleviate such possible concerns.

USER DATA ENTRY/MODIFICATION

(Eg : Student record updates - Address Change, Forward Graduation. Application). One aspect of implementing a multipurpose, multifunction smart ID system would be to reduce administrative costs. If students can perform their minor data entry work, such as student record updates, address changes, and forward graduation applications this will help to reduce enquires and data entry. Self service terminals may therefore result in better service to students.

PILOT TEST .

One aspect of a pilot project is to identify mistakes which could occur during the final implementation. Depending on the size of the project, implementation of a multipurpose, multifunction smart ID card system can cost millions of dollars. It is advisable that a pilot project identifies the weak points, mistakes and omitted details. The universities which had conducted pilot project(s) emphasised their importance during the first round questionnaire.

PHASED IMPLEMENTATION.

Phase implementation can help the university to implement the system step by step, rather than having to invest

POSSIBLE SUCCESS FACTORS FOR UNIVERSITIES

everything at the beginning of the project. 15 out of the 32 schemes implemented their system in a number of phases. These varied from 2 to 6 phases.

PROFITABILITY OF CARD SCHEME (EG SUBSIDISATION FROM BANKS/PHONE COMPANIES NECESSARY).

There are various ways of getting additional income for the university from a smart card system without charging students. 6 out of 32 schemes gained profits from the project (see Table 6.26 in Appendix 6). Possible opportunities include:

- Signing bonuses - (Eg : Number of purchases from the vending machine).
- Share in discount fees.
- Bank.
- Interest on account balances.
- Royalty payment from bank (Depending on number of accounts).
- Revenue from ATM use.
- Commissions from point of sale.
- Telephone.
- Percentage from the Telephone company - Commission from long distance calls.
- Royalty payment from telecommunications company (Depending on number of links).
- Special edition card sales - $ 10.00, $ 25.00 and $ 50.00 cash on card.
- Expanded card base - Visitors, Alumni, Collectors.
- Id replacement cost.
- Increased avenues of income expected.
- Reduced overheads expected.

FLEXIBLE VENDOR RELATIONS

The trading partner relations between universities and solution providers can have a significant effect on the working of a smart card system, which may span several years. In the first round questionnaire several solution providers mentioned that the support obtained from the university was unsatisfactory. Some of the common worries from the solution providers point of view were: politics at the university, general incomplete site preparation, organisational issues, to "get all departments under one umbrella". If the university is unable to keep flexible vendor relationships it may affect their long term goals.

CARD PROVIDES PINS FOR WALLET AND STUDENT INFORMATION (PRIVACY AND SECURITY ISSUES).

When we discuss smart cards, privacy and security aspects of the stored data are a critical area. At the moment personal data such as a student's medical history is not typically stored in a smart ID card. But more sensitive information may be recorded if the system scope expands. Further more, there should be a secure place to store electronic cash. Some universities have provided PINs to protect electronic cash. One university in Canada protected the electronic purse only for transactions greater than $10. Some universities do not protect the electronic purse by using a PIN because of restrictions on the amount stored in the electronic purse. According to the first round survey 25 out of 32 schemes are using the electronic purse feature. 12 out of 25 schemes are not protected by a PIN but have controls over the maximum amount deposited.

DISASTER RECOVERY PLAN IN PLACE.

For various reasons computers and computer systems are subject to regular breakdowns. As a result of this there may be inconvenience to the university as well as to the user. Depending on the degree of inconvenience or problems caused, implementing a disaster recovery plan may be an essential feature of an on-line system. In case of failure, a proper disaster recovery plan will result in faster recovery. According to the first round survey, 11 out of 32 schemes have a properly defined disaster recovery plan.

Respondents were also encouraged to include in their reply any factor they considered important or relevant which had not been highlighted in the first round of responses.

A list of failure factors derived from the first round answers was also prepared. Failure factors were derived separately, as factors likely to promote success are not necessarily the same as those likely to cause failure:

Table 6: Possible Smart Card Failure Factors for Universities

POSSIBLE FAILURE FACTORS FOR UNIVERSITIES
STUDENTS PERCEIVED LOSS OF PRIVACY
There are many myths associated with smart cards, such as students' concerns that their activities are being monitored by the University. This is typically not possible and the universities have no wish to collect this information. However, 25 percent of respondents mentioned that the students' perception is that private information would be more freely accessible to university administrators/internal bodies. Since 20 percent of respondents mentioned that students' perception is that the private information would be more freely accessible to external bodies (eg : off campus transactions, bank) it may be that this perception is crucial.
STUDENTS EXPERIENCED LOSS OF PRIVACY
If students think someone is monitoring their activities, it is useful to identify whether they have actually experienced a loss of privacy. Rating this factor would elaborate whether this is a fear or actually happens.
TECHNICAL DIFFICULTIES
For various reasons computers and computer systems are subject to regular breakdowns, and inconvenience to the university as well as to the user. More than 10 percent of the respondents mentioned that students are not satisfied with regular computer system breakdowns.
CULTURAL TABOOS.
Students often go overseas to complete higher education. They come with different cultural backgrounds and different beliefs. Smart cards may be a new experience. Some universities participating in the first round mentioned that they experienced culture-related problems with students coming from different countries. None of the respondents directly listed the examples, although they mentioned that students faced difficulties with different cultural backgrounds and different beliefs.
RELIGIOUS OBLIGATIONS
Secondly some countries and some universities may also adhere to various religious obligations. One university participating in the first round Delphi survey mentioned that they faced religious barriers to its implementation. One mentioned a prophesy (didn't mention which religion) regarding a cashless society signalling an evil. Such unexpected issues could severely effect the success of a smart card university project, depending on the social demographics of the university.

Success and Failure Factors for Solution Providers

Solution providers are a body external from the university administration umbrella and dealing with number of implementations with different universities; hence their focus is different. Analysis of the first round questionnaire derived a list of success and failure indicators from the solution provider's point of view. Identified indicators were common to many solution providers. The second round questionnaire for solution providers contained a list of 10 success factors and 5 failure factors for the respondents to rank.

Table 7: Possible Smart Card Success Factors for Solution Providers

POSSIBLE SUCCESS FACTORS FOR SOLUTION PROVIDERS
EXPERIENCE OF SOLUTION PROVIDERS IN LOCAL MARKET.
One solution provider participating in the project installed the system in nearly 400 universities and another installed the system in over 50 universities in 20 countries. Depending on the requirements, implementation of a multipurpose, multifunction smart ID card system will cost millions of dollars. The experience the solution provider has, particularly in the local market, can affect the success of the implementation considerably.
OVERALL YEARS OF EXPERIENCE OF PROVIDER.
The solution provider may or may not have experience in implementing a multipurpose, multifunction smart ID card in a university, but may have more general experience about smart card projects. Some solution providers participating in the first round questionnaire have considerable experience in other smart card projects, but less in university ID card systems.

POSSIBLE SUCCESS FACTORS FOR SOLUTION PROVIDERS

SOPHISTICATION OF SOLUTIONS PROVIDED.

According to the first round questionnaire the number of facilities incorporated in the ID card by different solution providers has reached up to 16. Different universities are using different type of cards. They vary from a magnetic stripe card, smart card, contactless card, combination of the above, multiple chip card. The sophistication and flexibility of the system implemented may effect the ease or even feasibility of further expansions such as tying up different facilities, replacing them with a different type of card or to cope with any modifications requires by the user.

PILOT PROJECT USED.

According to the first round questionnaire some solution providers do not encourage the university to conduct a pilot project, despite the benefits it could bring. This issue was listed in an effort to gain further information as to why pilots may not be recommended by solution providers in some circumstances.

VENDOR INVOLVEMENT IN IMPLEMENTATION.

According to the first questionnaire, some universities mentioned that after signing the contract, some vendor participation was not satisfactory. Some of the common worries from the university point of view were: support from the supplier, delays getting equipment, lack of co-operation from the supplier, the performance of the purse transactions where there were performance problems, which resulted in low levels of acceptance, technical problems with the purse function. These were the common complaints obtained from all respondents. If the universities have negative attitudes about the involvement of the vendor during the implementation it may affect long term relationships with the vendor. Therefore it is important to identify the views of the vendor (see Appendix 6.22).

PHASED IMPLEMENTATION.

A multipurpose, multifunction smart ID card system is a fairly new concept. Users may take some time to become familiar with the new implementation so as to obtain the maximum benefits. Phased implementation will help non-technical users have a better understanding about the new ID card.

NUMBER OF LANGUAGES /MARKETS SUPPORTED

During the first survey some respondents mentioned that they planned to implement the same system in different languages to capture markets in different countries.

USE OF INTERNATIONAL STANDARDS (EG ISO)

For any implementation, adhering to standards is very important, because standards are documented agreements containing technical specifications such as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose. Adhering to standards provides the opportunity to implement systems in an open systems architecture. According to the respondents to the first round questionnaire, all solution providers met ISO standards.

AVAILABILITY OF BACKUP FACILITIES

Backup facilities are a major requirement for a computer system. Results of the first round questionnaire show that the solution providers are not responsible for a disaster recovery plan or backup facilities unless they provided the hard ware. If there is a major failure such as a hard disk failure or destruction of the central office, backups would be the only solution to get the system back into operation.

The first round questionnaire revealed that the perceptions of the three parties regarding disaster recovery plans were as follows: University – fewer than 10 percent of the respondents mentioned that students are not satisfied with regular computer system breakdowns. Solution providers – just over 10 percent of respondents mentioned that students are not satisfied with regular computer system breakdowns. More than 20 percent didn't agree and the rest didn't respond. Users - 8 percent of respondents mentioned that students are not satisfied with regular computer system breakdowns. These results suggest that students are not very concerned with computer failures – perhaps because of lack of information.

PARTNERSHIPS WITH PTTS/MACHINE PRODUCERS.

Keeping partnerships with other vendors or organisations are essential for large scale implementations because the solution providers may not be able to provide a total solution without forming joint ventures. Results of the first round questionnaire showed that solution providers had joint ventures with several vendors or organisations, including vending companies, laundry companies, telephone companies, network security companies, card manufacturers and banks.

Failure factors derived for solution providers to consider were:

Table 8: Possible Smart Card Failure Factors for Solution Providers

POSSIBLE FAILURE FACTORS FOR SOLUTION PROVIDERS
INADEQUATE SITE PREPARATION. Inadequate site preparation was mentioned in the first round as a possible cause of an unsuccessful implementation of the project, and includes: • Improper wiring. • Inadequate space to install equipment. • Not assigning a project leader.
CARD ISSUE PROCESS. Lack of planning and co-ordination of the card issuing process will contribute to unnecessary delays in the project. During the first survey some solution providers identified this issue as having been a problem with the universities they were working with.
CHANGES TO EQUIPMENT DURING THE IMPLEMENTATION. These may delay project completion and add additional expenses to the overall project.
LACK OF PIN FOR ELECTRONIC WALLET AND STUDENT INFORMATION. *As for university list above*
RELIGIOUS OBJECTIONS. *As for university list above.*

Summary

Universities have been among the most active organisations investigating the potential of multi-purpose, multi-function smart card systems, because of the obvious match between the types and numbers of applications suited to smart cards. Despite successful implementations overseas, however, there have so far been few investigations of smart cards by Australian Universities, and no successful implementations of smart card projects in the Australian tertiary sector.

This paper has described the design and first round results of a Delphi study designed to investigate the issues affecting multipurpose, multifunction smart ID card applications in university environments. The result of this process was the elicitation of a set of possible success and failure factors affecting such implementations – according to the expert views of two primary stakeholder groups: the university implementers, and the vendors of smart card solutions.

The results of the Delphi study conducted can be generalised to Australian universities to the extent their settings are similar:

1. *By function*: the nature of the functions smart cards are used to improve in overseas universities is consistent across hundreds of universities, and many different countries: a student id mechanism, a photocopy card, a vending machine card, a wallet, etc
2. *By environment*: the university sector in Australia has the same purpose and essential structure of those overseas: students congregate on campuses to attend classes. They form the nature of the campus, with many study-related services being used in a centralised place. The vendors which provide such systems, and the technology involved, are all available in Australia.
3. *By user*: students in Australia gain the same outcomes and have the same requirements of a university campus as in other countries. Given the degree of commonality of answers received from the various universities, and the apparent lack of regional/cultural factors

present in the results, the results of this study would suggest that any university smart card implementation project could benefit from observing the factors found. While more detailed investigation into these kinds of issues is clearly required, it may be argued that the results obtained from this study are relevant to Australian universities pursuing smart card implementations.

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