

# **Introducing Multi-purpose, Multi-function Smart Cards to Australian Universities**

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## **Abstract**

As their application area and the number of applications supported increase, the benefits of card technologies (and, in particular, of smart cards) become more widely accepted. These benefits are especially relevant to Universities — environments in which there are many uses for smart cards. Increasing numbers of universities around the world have some kind of “smart” student card, many of which are being developed to support multiple functions on a single card.

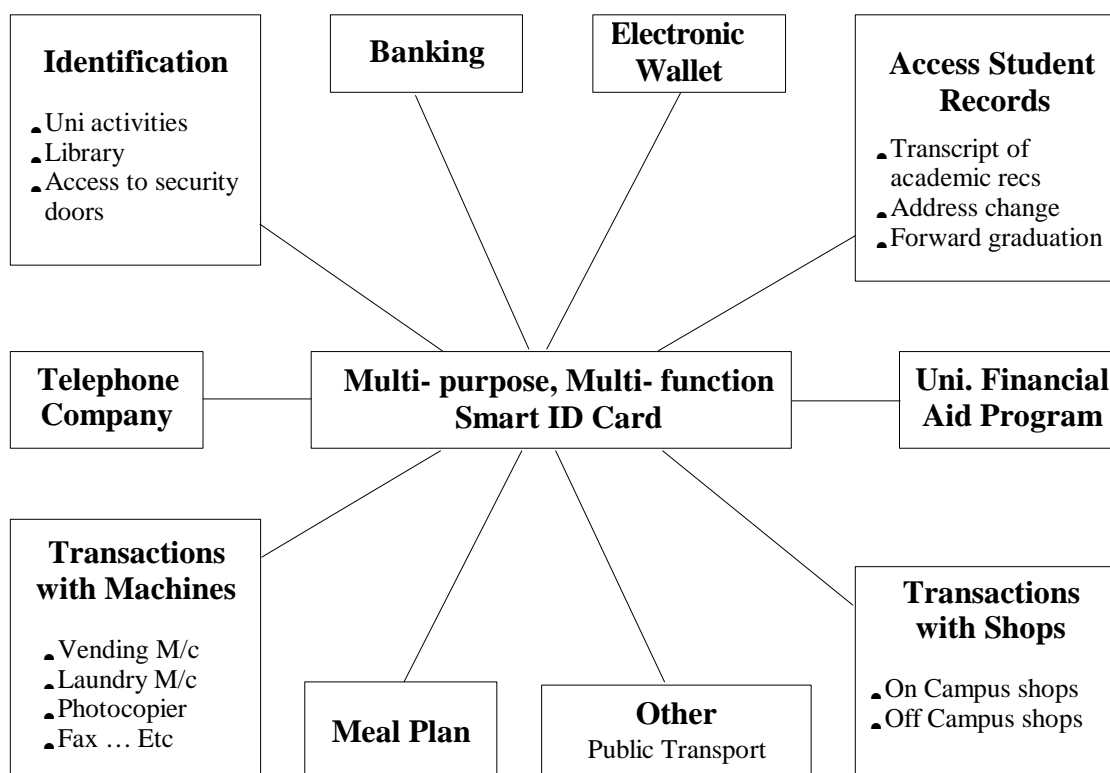
As yet, no Australian universities have successfully introduced a smart card, although there are several such implementations in New Zealand, and well over a hundred such implementations world-wide. This paper describes a research project in progress which investigates the issues associated with introducing smart cards to Australian Universities — particularly the benefits and success factors associated with introducing a multi-purpose, multi-function card.

## **Introduction**

Card technologies such as magnetic cards and newer, “smarter” cards having a micro-processor chip are playing an increasingly important role in modern life. Their possible uses vary from providing access to banking facilities and the storage of electronic money, allowing easy access to facilities such as telephone and photocopying, to providing a secure identification and authorisation mechanism. A single card has the potential to replace all the cards and documents currently found in your wallet — for example, your driver’s licence, credit card(s), ATM cards, video rental cards, frequent flyer cards, staff identification cards, library cards, as well as the coins and currency notes.

Smart cards are increasingly being used around the world for such applications because of their ability to store and protect relatively large amounts of data: more than the information printed on a card, or contained in a barcode. In Germany, for instance, every citizen is being issued a health card identifying the holder's insurance provider and account number — and plans are in place to add medical information such as the name of the holder's doctor, blood type, allergies, medications, contact details for next of kin, and instructions in case of emergency (Fancher, 1997). The Singaporean government commenced work on a national card scheme in 1991 which will allow them to completely withdraw currency notes and coins from circulation (see NUS, 1997). The potential a smart card solution offers for solving the problem of authenticating users and transactions over insecure networks means it is currently seen as the enabling technology which will support rapid growth in the use of electronic commerce over the internet.

The types of cards currently available range from simple access cards, used to achieve computer access (or physical entry or passage), through to more sophisticated cards which can be used as electronic purses, electronic wallets, stored value cards and universal prepayment cards (Fancher, 1997). A true smart card is an integrated circuit (IC) card with memory and a microcontroller, which makes it capable of making decisions. Physically, a smart card is a plastic card of the same dimensions as today's credit cards, having a chip embedded within it. This chip has 100 times the storage capacity of the magnetic stripe found on the back of the average credit card, and allows up to 1 million write cycles. The placement of the chip is standardised, allowing the card to be used in existing terminals such as ATMs, as well as allowing readers to be built into vehicles such as vending machines or telephones.



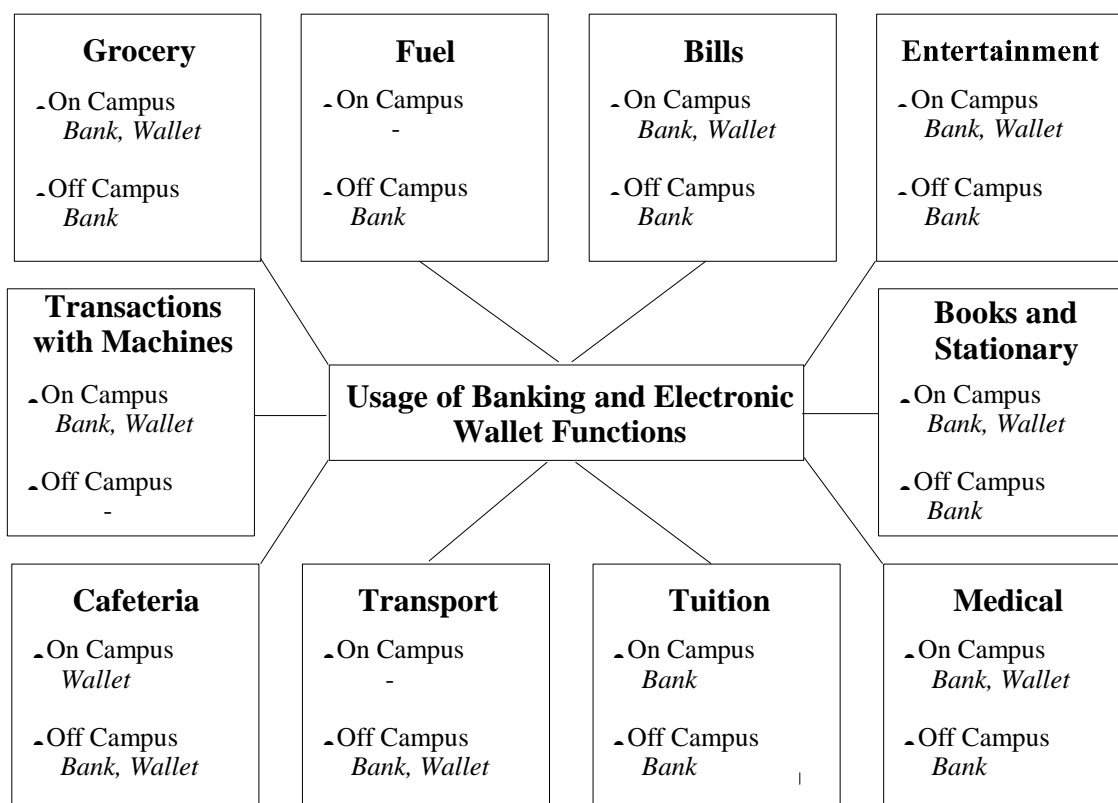
**Figure 1: Functions of the Multi-purpose, Multi-function Smart ID Card**

## Universities and the Proliferation of Cards

As the number of useful applications for smart cards has increased, so has the number of disparate applications developed. Multi-application cards are still quite rare, and the number of applications integrated has been slim. One domain which has been active in pursuing multi-application (or multi-function) cards is the University sector, because of the number of functions involved in managing student life. 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, telephone use, etc.

Universities therefore provide an environment which is ideally for the introduction of a multi-function card. In 1991 magnetic stripe cards were first introduced to universities (Northern University, 1997). Due to their lower production costs, magnetic stripe cards are more cost-effective than smart cards, but their functionality is more limited and they do not provide the same level of security. In 1994, Florida State University in the USA introduced the first smart ID card and there are now over 200 universities and colleges in the USA alone with magnetic or smart card schemes. Figure 1 shows the variety of potential functions which can be linked to a smart student card.

Figure 2 expands on the potential applications of a student card, adding banking and electronic wallet facilities — and shows the various transactions such a card could support in both on- and off-campus shops.



**Figure 2: Banking and Electronic Wallet Functions of a Smart Card**

Although the use of magnetic and smart cards in European and American Universities has grown steadily over the past five years, there have so far been no successful implementations of smart card projects in the Australian tertiary sector.

## **Investigating the Applicability of Multi-function cards in the Australian University Sector**

The research project which this paper describes focuses on investigating the issues relevant to the introduction of multi-purpose, multi-function smart cards in Australian Universities. In selecting an appropriate research method, we were influenced by two major considerations:

- 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;
- although no Australian University has successfully implemented a smart card scheme, they are quite commonplace overseas (see appendix A). 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. In the early 1950s, the term Delphi was used to describe a reliable consensus of opinion, obtained from group of experts by a series of intensive questionnaires interspersed with controlled opinion feedback (Linstone and Turoff, 1975). This approach is characterised as “*a method for the systematic solicitation and collation of judgements on a particular topic through a set of carefully designed sequential questionnaires interspersed with summarised information on feedback of opinions derived from earlier responses*” (Delbecq, *et al.* 1975:10).

Delphi is particularly useful when accurate information is unavailable or expensive to obtain, or where evaluation models require subjective inputs to the point where they become the dominating parameters (Linstone and Turoff, 1975:10). The survey is the most common technique of Delphi application. Delphi surveys are specially designed to obtain the opinion of experts and such a survey has three special features;

1. Anonymity of participants.
2. Iteration and controlled feedback between rounds.
3. Statistical summary of group responses.

We decided to use a Delphi survey which 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. Administering the survey via email allowed us access to a much wider sample group than would otherwise have been possible for a one-year masters degree, enabling us to obtain reliable opinion from a group of experts. This approach also allowed us to collate and return information to the participants quickly, thus improving the percentage of participants remaining committed to a second round of questions (a persistent problem with the Delphi technique).

## Research Design

A research design is a logically designed plan allowing the researcher to derive appropriate conclusions from his/her initial research question (Yin, 1989). After deciding on the Delphi technique, we made the following design decisions:

- The appropriate number of participants would be between 20–30 in total (composed of 15-20 Universities, 5-10 Solution Providers and 5-10 Actual Users).
- Electronic mail would be used to communicate with participants.
- Since time was a limiting factor, it would be most appropriate to have only 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 would be an enormous body of information.
- More open-ended (less structured) questions will be used for the second round questionnaire to allow us to obtain opinions on success factors for smart card introduction.

The main steps involved in conducting the Delphi survey included:

- Identifying and contacting participants to gain their agreement.
- Designing and sending the first round questionnaire.
- Analysing the results of the first round.
- Producing feedback from the first round.
- Designing and sending the second round questionnaire.
- Analysing the results of the second round questionnaire.
- Preparing the final presentation of results.

So far, one round of the survey has been completed. 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 users of multi-purpose and multi-function ID cards). We began by compiling a list of universities and vendors who have participated in smart card schemes. We 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 rather than using 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.

We sent an invitation letter to 145 prospective participants by email. After this initial contact, 59 individuals and organisations (39 Universities and 13 Solution Providers), from 12 different countries, agreed to participate in the survey. Of this 59, 19 Universities and 6 Solution Providers responded to the questionnaire. We also received responses from 7 users of smart cards schemes in the tertiary sector, who were selected through personal contacts, but who were not sent the invitation letter. The 19 participant universities were from 6 countries; the 6 participant solution providers were from 3 countries; and the 7 users were all from the USA.

The aims of the first round of the survey were to identify:

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- How the different universities had implemented the multi-purpose, multi-function ID card system.
- How the different solution providers had implemented the multi-purpose, multi-function ID card system.
- The perceptions held by the different users of the multi-purpose, multi-function ID card system.
- Whether there are any cross cultural differences in experiences with multi-purpose, multi-function ID cards.

90 % of the questions were limited to “Yes“ or “No“, or to short answers. The questionnaire prepared for the universities contained 91 questions under 21 headings:

- |  |   |
|--|---|
| 1. The University  | 11. Pilot Project                           |
| 2. The Card  | 12. Implementation                          |
| 3. The Project   | 13. Vendors                                 |
| 4. Banking Features  | 14. Advantages                              |
| 5. Electronic Purse  | 15. Disaster Recovery Plan                  |
| 6. Student Accounts (Cash deposits) maintained by the University | 16. Post Implementation Review              |
| 7. The Uni. Financial Aid Program                                | 17. Expected Changes / Enhancements         |
| 8. Facilities  | 18. Other Successful University Id Projects |
| 9. Telephone Company   | 19. Your Involvement                        |
| 10. Special Features   | 20. Financial                               |
|  | 21. Comments                                |

The questionnaire sent to solution providers contained 68 questions under 17 headings:

- |                              |   |
|------------------------------|---|
| 1. Provider                  | 10. Advantages                              |
| 2. Background of the Company | 11. Post Implementation Review              |
| 3. Products (University Id)  | 12. Disaster Recovery Plan                  |
| 4. Facilities                | 13. Expected Changes / Enhancements         |
| 5. Special Features          | 14. Other Successful University Id Projects |
| 6. Pilot Project             | 15. Joint Ventures                          |
| 7. Implementation            | 16. Other Smart Card Projects               |
| 8. Clients                   | 17. Comments                                |
| 9. Information               |   |

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

- |                                 |                             |
|---------------------------------|-----------------------------|
| 1. User                         | 5. Problems                 |
| 2. Background of the University | 6. Conditions / Limitations |
| 3. Facilities                   | 7. Comments                 |
| 4. Advantages / Benefits        |                             |

We have yet to fully analyse the results received from this first round, but preliminary analysis suggests that:

- 10 out of the 19 schemes described use magnetic stripe cards (with up to two stripes per card), while the remaining 9 have a chip present on the card. Only one scheme uses a chip alone (ie without a magnetic stripe)
- every university which responded uses its card as a student identification card
- every university which responded has at least 3 functions tied to its student card, with one university having 13 functions
- the most commonly used functions, in addition to student identification, are: meal plans;

electronic purse; and access control to facilities such as parking or building access.

Further analysis of this round of replies will be conducted over the next few weeks, before a second round questionnaire is prepared. This questionnaire will summarise the results of the first round, providing the respondents with sufficient information to allow them to answer the more opinion-dependent questions which the second round will contain.

## **Conclusion**

The increasing uptake of smart cards and magnetic stripe cards has resulted from the increased numbers of applications which such cards support. The tertiary education sector, in particular, has adopted this technology to resolve the problems of student administration, security and service provision. But while there are many successful examples of universities and colleges around the world which have adopted smart cards, there is at present no such example within Australia. This seems curious, since the factors involved in student administration and service provision in Australia differ little (if at all) from those experience overseas.

This paper has reported on the current status of a research project focussed on investigating the issues effecting the introduction of multi-purpose, multi-function smart cards to Australian Universities. In using a Delphi survey to gain the views of recognised experts in the field, we hope to identify factors on the basis of which we may develop a set of criteria relevant to the Australian University sector.

While the research reported here is still at an early stage of analysis, we are already finding a very consistent pattern of implementation from the members of our Delphi panel. We have deliberately set out to discover whether cultural factors are important in the successful implementation of a smart card solution for a university — but although it is still too early to make any dependable statements on the basis of our findings, we suspect that such factors will prove to be unimportant in the implementations reported by our respondents. What fascinates us at present is which factors will prove to resolve the conundrum of the Australian failure to implement successful smart card solutions for the university sector.

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