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Bernard C.Y. Tan
National University of Singapore, btan@comp.nus.edu.sg

Taizan Chan
Queensland University of Technology
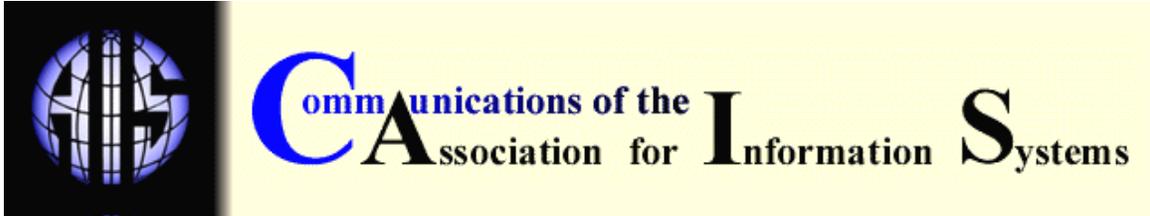
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THE INFORMATION SYSTEMS ACADEMIC DISCIPLINE IN SINGAPORE

Bernard C.Y. Tan
Department of Information Systems
National University of Singapore
btan@comp.nus.edu.sg

Taizan Chan
Faculty of Information Technology
Queensland University of Technology

ABSTRACT

The global downturn in demand for IT skills has not left Singapore unscathed. While the demand for information systems graduates has not been as adversely affected as that for traditional computer science ones, there appears to be a drop in the entry quality of students seeking to do information systems degrees. While there appears to be some turnaround on the horizon, to better prepare for the future it is timely to examine the current state of IS as a discipline in Singapore and understand what might be the driving forces that shape it. Using Whitley's theory of scientific change as a theoretical framework [1984a, 1984b], this case study seeks to explore the degree of professionalization and the maturity of IS as a discipline in Singapore through analysis of data gathered from in-depth interviews and secondary data sources. It is found that of the four constructs proposed by Whitley for determining if a discipline is a mature, distinct scientific one, the IS discipline in Singapore clearly satisfies three: the discipline has a high level of professionalization, strong scientific reputation, and well-established research competence and skills. While the IS researchers agree that the discipline has a common vocabulary with which to communicate with one another, they also agree that it is not unknown to the researchers outside the discipline and thus, in this aspect, the discipline only satisfies part of the fourth construct in Whitley's theory.

Keywords: Information Systems, IS discipline, Singapore universities, Asia Pacific, case study

I. INTRODUCTION

Singapore, with a land area of approximately 700 square kilometres and a population of 4.5 million, is one of the most densely populated countries in the world. Singapore has a highly successful free-market economy which depends heavily on exports, particularly electronics, chemicals, information technology, and services. This success is facilitated by Singapore's port infrastructure and skilled workforce as they provide easier access to markets for both importing and exporting, and also provide the skills needed to refine imports into exports. In 2006, the per capita GDP was US$29,474 while the unemployment rate was 3.6 percent [Singapore Department of Statistics 2007].

The unprecedented downturn in demand for Information Technology (IT) skills worldwide over the past three or four years, however, has not left Singapore unscathed. In particular, demand for IT graduates with technical, traditional computer-science skills has dropped significantly. While the demand for Information Systems graduates has not been as adversely affected, this downturn has resulted in a substantial drop in the number of students seeking to pursue IT courses in Singapore. Corresponding to the industry demand trend, the number of students enrolled in computer-science courses has dropped; and while the number of students enrolled in IS courses remains strong, there has been a drop in the entry quality of these students.

Nevertheless, looking forward, there is value in examining the current state of Information Systems in Singapore universities. Given that the demand for IT skills appears to be on the rise again, such an examination, in particular of the forces and threats that have shaped the IS research directions and curriculum in Singapore, offers the prospect that local institutions and academics will be better placed both to take advantage of emerging opportunities and to minimise the impact of threats to the Information Systems discipline. The lessons learned from Singapore universities may also provide insights for other universities that need to deal with similar opportunities and threats currently. This paper reports such a case study, into the state of the Information Systems discipline in Singapore universities.

II. PURPOSE OF THE SINGAPORE STUDY

The Singapore study aims to document current characteristics of Information Systems programs and Information Systems research across universities in Singapore. The broad study also seeks: to assess the strength of the IS presence in Singapore universities, to evaluate the maturity of IS as an academic discipline in Singapore, to identify emerging trends in IS in Singapore universities, and to identify main influences on IS in Singapore universities. These aims are to be seen in the context of debate about what Information Systems is and, significantly, whether IS can legitimately claim to be a distinct academic discipline.

III. THE RESEARCH METHOD

The Singapore study utilizes the detailed case study method similar to that employed in the first case study, that of the state of Queensland, Australia [Smyth and Gable 2006]. It draws heavily on Yin [2003] and Walsham [1995].

The main objectives in adopting the Queensland Study protocol were to facilitate:

- Comparability across Singapore and other studies employing the same protocol;
- Consistency across the individual case studies; and
- Efficiency in the data gathering process.

The principal data gathering method used in the case study was interviewing. Only the deans or the heads of the IS schools or departments in each Singapore university were interviewed as it was believed that only these participants are able to provide all the necessary data for the required analysis (see the theoretical framework following). Existing documentary and archival material was also gathered to supplement the interview data and to provide some triangulation of observations. The interviews were semi-structured, of about one-hour duration, with emphasis on broad perceptions by the interviewee on the state of Information Systems in his/her university, points of differentiation, and distinctive features of Information Systems in that university and in other Singapore universities.

IV. THEORETICAL FRAMEWORK GUIDING THE STUDY

Adopting the framework of Whitley's theory of scientific change [1984a, 1984b], this study aims to gather evidence to enable us to establish:

(1) *The degree of professionalization of IS as a discipline in Singapore.* This will be established by analysing the extent to which the IS curriculum and research agenda in the various institutions is independent of local contingencies such as political pressures or governmental policies. The evidence we seek focuses on the extent to which various institutions differ in their IS curriculum and research directions. A strong overlap or similarities across institutions, and a distinctive Singaporean emphasis, would suggest strong local contingency influences and hence low degree of professionalization.

(2) *Maturity of Information Systems as a scientific field in Singapore.* This will be assessed through evidence on the presence of the following characteristics of a scientific discipline:

- *The scientific reputations of IS as a discipline had both become socially prestigious and "control critical rewards."* This will be established through evidence such as the perceived potential rewards and career path of an IS academic as well as external positions held by prominent IS researchers in Singapore.

- *Standards of research competence and skills in IS become established.* This will be determined by (1) both the quality of the research output of Singapore IS academics based on the tier of the journals and conferences in which their works are published and the level of output in these outlets; and (2) their ability to attract research funding and industry collaboration.

- *A unique symbol system is developed that allows the exclusion of outsiders and unambiguous communication between initiates within the IS discipline.* This will be determined by the perceived extent to which academics within and from other discipline have problems in understanding some IS-specific terminology or concepts.

V. THE UNIVERSITIES IN THIS STUDY

In this study, data was gathered from all universities in Singapore. There are three universities in Singapore, all of which have only a single campus. These universities are: National University of Singapore (NUS), Nanyang Technological University (NTU), and Singapore Management University (SMU). All three universities teach Information Systems. The universities, and their sizes, in total number of students and staff, are shown in Table 1 [NTU 2007; NUS 2007; SMU 2007].

Table 1. Singapore Universities

University	Undergraduate Students	Postgraduate Students	Academic (Faculty and Research staff)	Other staff
National University of Singapore	23,469	9,075	3,260	3607
Nanyang Technological University	19,114	8,538	1,663	1616
Singapore Management University	4,530	213	155	N/A

VI. RELATIVE SIZE OF THE IS PRESENCE IN THE SINGAPORE UNIVERSITIES

While there is only a single administrative group within the National University of Singapore and Singapore Management University that is involved with IS research and courses, there are three such groups within Nanyang Technological University in which IS-related subjects and research are conducted: Division of Information Systems in the School of Computing Engineering, School of Communications and Information, and the Information Technology and Operations

Management Division of the Nanyang Business School. The Division of Information Systems in the School of Computing Engineering does not offer any full IS course, while the School of Communications and Information does offer a Master in Information Systems but it is more closely related to library science than to Information Technology. These two groups are thus excluded from this case study. Only interviewees from the third group at the Nanyang Business School, the Information Technology and Operations Management division, are included.

An indication of the Information Systems presence at these universities is given in Table 2. It is interesting to note that the number of IS students appears to be proportional to the entire population of students in respective universities, although there appears to be a higher staff to student ratio in National University

Table 2. The Size of the IS Presence in Singapore Universities

University	No. of IS Academics	No. of IS Students
National University of Singapore	30	170
Nanyang Technological University	16	100-150*
Singapore Management University	24	120

* Note that this number includes students who are doing IS as second specialization (with the first specialization being either finance or accountancy)

VII. THE ADMINISTRATIVE PLACEMENT OF IS IN SINGAPORE UNIVERSITIES

The administrative placement of IS in the three universities is shown in Table 3. As indicated, their placements in the three universities are different. As discussed further following, these placements appear to reflect several differences regarding the curriculum, the status and the "importance" of IS as a discipline across these three institutions.

Table 3. Administrative Placement of the IS Group in Singapore Universities, November 2005

University	Administrative Entity	Home Faculty/School
National University of Singapore	Department of Information Systems	School of Computing
Nanyang Technological University	Division of Information Technology and Operations Management	Nanyang Business School
Singapore Management University	School of Information Systems	University

The School of Information Systems in Singapore Management University is the highest in term of administrative hierarchy, followed by the Department of Information Systems in National University of Singapore within the School of Computing. While the division of Information Technology and Operations Management also resides within a school (the Nanyang School of Business), the administrative unit of "division" in the case of Nanyang Technological University appears to have a lower administrative placement than that of "department" in the case of National University Singapore.

Being within the School of Computing, the IS courses offered in National University Singapore appear to be more technical than those offered in the other universities. While it focuses on the deployment of IT (rather than development of IT as in the Department of Computer Science), it

still includes elements of programming and systems development. In addition, while IS in the National University of Singapore appears to be recognized as a distinct and important discipline, there is a sense that IS within the Nanyang Business School of Nanyang Technological University is less "prestigious" than other traditional business disciplines such as banking and finance. Furthermore, the IS curriculum in Nanyang Technological University appears to position IS more in a supporting role in relation to other business functions, rather than as a separate, stand-alone discipline. As one of the five schools headed by a dean directly under the university, the School of Information System in Singapore Management University is clearly recognized as an important and distinct discipline. IS in Singapore Management University captures the intersection between IT and business: the context is that of the deployment of Computer Science and IT capability in the creation of business solutions and their impact on business processes.

In summary, from observations in Singapore, the nature of the curriculum and the status of the discipline of IS within a university appears to be a close reflection of the administrative placement of IS within the university.

VIII. DISTINCTIVE FEATURES OF INFORMATION SYSTEMS CURRICULUM

To understand the design of the IS curriculum in the Singapore universities, particularly from the theoretical viewpoint adopted in this study, it is important that we first examine any local contingencies that may play a role in that design.

Formed in December 1999 as a merger of two prior government regulatory bodies (National Computer Board and Telecommunication Authority of Singapore), the Infocomm Development Authority (IDA) of Singapore has as its strategic goal: "to cultivate a vibrant and competitive infocomm industry in Singapore - one that attracts foreign investment and sustains long-term GDP growth through innovative infocomm technology development, deployment, and usage in Singapore - in order to enhance the global economic competitiveness of Singapore" [IDA 2007]. Among the many initiatives and activities of the Infocomm Development Authority in achieving this goal are annual surveys on the Infocomm industry and Infocomm manpower in Singapore. These surveys provide insights into the required skill set in Singapore, and serve as inputs to the design of the IT curricula in Singapore.

Thus, while the IS curriculum in National University of Singapore follows closely the curriculum outlined by the Association of Information Systems, it includes some distinctive subjects developed on advice from an industry board and taking account of the results from these IDA surveys.

The IS curriculum in Nanyang Technological University, also receives input from IDA surveys, but is distinctive in that it focuses more on IS/IT applications in the context of other business disciplines such as finance and banking, the service sector, and accounting.

The IS curriculum in Singapore Management University is distinct from that of Nanyang Technological University and National University of Singapore in that, while National University of Singapore is more technical-oriented, and Nanyang Technological University more business-oriented, students in Singapore Management University have to do not only IT and business core units, they are also required to do liberal arts core units.

While the IS curriculum in National University of Singapore aims to produce technically-strong students that could effectively deploy IT for business, Nanyang Technological University aims to produce business students who understand IT and are able to identify and deploy IT in enhancing/supporting their business functions. Singapore Management University aims to produce IS students who understand business processes/architecture and how IT could be deployed in the context of these processes. In that regard, in addition to research-track academics, Singapore Management University also have practice-track teaching staff.

While both National University of Singapore and Nanyang Technological University design their curriculum partly in response to the feedback from IDA, they both feel that they are not directly affected nor pressured by any other local factors or contingencies. Similarly, the school of IS in Singapore Management University has complete freedom in formulating their own curriculum but agree that the inputs from the government and the local industry have been of great help in designing curriculum. Table 4 lists the various IS degree programs offered by the respective universities.

Table 4. Information Systems Courses in Singapore Universities

University	Undergraduate Courses/Programs	Postgraduate Courses/Programs
National University of Singapore	Bachelor of Computing (IS) Bachelor of Computing (E-commerce)	Master by Coursework PhD
Nanyang Technological University	Bachelor of Business (IS) Bachelor of Business (Accountancy with Second Specialisation in IS) Bachelor of Business (Finance with Second Specialisation in IS)	Master in IS PhD
Singapore Management University	Bachelor of Science in IS	PhD program in development

It is useful to note also that the Infocomm Development Authority of Singapore (http://www.ida.gov.sg/home/index.aspx) has recently released a 10-year Infocomm master plan (Intelligent Nation 2015 or iN2015) that will serve as "the blueprint to navigate Singapore exhilarating transition into a global city, universally recognised as an enviable synthesis of technology, infrastructure, enterprise, and manpower" (http://www.in2015.sg/). A key emphasis of that plan is to produce many techno-strategists by 2015. As identified by a study respondent, the skill set required from these techno-strategists would be a combination of IS and business knowledge and skills, which the IS programs in Singapore are well placed to provide. As a consequence, most of the IS universities in Singapore are re-aligning their programs to this national plan. It is perhaps because of the ability of the IS institutions in Singapore to recognize the changing needs of the country and quickly respond to these needs that they have been able to produce students that match the country needs, and therefore maintain industry demand for the IS graduates.

IX. DISTINCTIVE FEATURES OF INFORMATION SYSTEMS RESEARCH

A distinct feature of the IS research in all the Singapore universities is that there is no hard research grouping among the academics. While there are some topics of current focus and interest (see Table 5), the research topics are often determined by individuals, with fluid and flexible collaborations among the academics.

IS research in both National University of Singapore and Nanyang Technological University employs a range of traditional IS research methods, both quantitative (experiments, surveys, economic modelling) and qualitative (case studies, interviews), with Nanyang Technological University relying slightly more on the qualitative methods (60 percent). Singapore Management University, on the other hand, employs methods from various disciplines. For example, research in the fields of data management, business intelligence, and information security and trusts relies

more on methods from computer science and engineering, while research in e-commerce relies on methods from the field of Artificial Intelligence, Operations Research, and Decision Support, while, again, research in IS resource management uses methods from the field of economics.

Table 5. IS Research Foci and Groupings for IS Research in Singapore Universities

University	Areas of IS Research Focus	IS Research Groupings
National University of Singapore	Knowledge management Information Privacy Mobile/Electronic Commerce	Individual but with flexible and fluid collaborations among individuals
Nanyang Technological University	Public-sector IT Transformation (e-government) ERP and packaged implementation IT-personnel Group-based systems	Mostly individual with no hard definition of research groupings
Singapore Management University	Data management Business Intelligence Information Security and Trust Business Software Architecture E-commerce and supply chains IS resource management	Mostly individual

The level of research output across the three universities is impressive, not only in quantity but also in terms of the quality of the outlets in which the research is published. An average of 10 to 15 top-tier journal publications per year is reported in one university, for example.

As observed in Table 5 previously, there appear to be different research focuses across the universities, with the research focus defined by the individuals or informal groups, rather than by any university or government contingencies (such as the Infocomm Development Authority).

X. KEY FIGURES WHO HAVE INFLUENCED IS IN SINGAPORE UNIVERSITIES

Dr. K. S. Raman is credited as the person who started from scratch, with the help of Professor Gordon Davis, the IS research and curriculum in National University of Singapore through the development of the IS program in the then Department of Computer and Information Sciences in the Faculty of Science. Professor K. K. Wei (who is currently with the City University of Hong Kong) is also cited as a key figure in the shaping of the current department of IS within National University of Singapore. Professor Izak Benbasat and Professor Haim Mendelson, who are advisers to the department, are also cited as key figures who have influenced the IS department. With regard to the division of IT and OM in Nanyang Technological University, Professor Neo Boon Seong, who later became the dean of the business school (but has now left NTU), was credited with elevating the status of IT and IS as a discipline within Nanyang Technological University. National Computer Board (the government IT regulatory body before its merger into Infocomm Development Authority of Singapore), and the early Institute of System Science (which is now a teaching institution) were also cited as having strong impact on the direction of technology research in Singapore. Professor K. K. Wei and Professor Bernard Tan are also cited as being influential in the development of the "traditional" IS discipline in Singapore [Huang and Hsu 2005].

XI. THE STATUS OF IS AS A DISTINCT DISCIPLINE IN SINGAPORE UNIVERSITIES

Overall, Information Systems is a recognized, distinct discipline in Singapore universities. Indeed, as an interviewee pointed out, the range of IS courses offered is extremely rich and wide-ranging, and the level of IS activities is very high for a country the size of Singapore. While the status of IS as a discipline differs somewhat across the universities (as reflected by the differing administrative placement of the IS unit), evidence from the case study suggests the following:

- *There is a high degree of "professionalization."* The main local "contingencies" that could potentially influence the IS discipline, such as the Infocomm Development Authority, while providing inputs and advice that are well-heeded by the universities, did not constrain the development of the curriculum nor the research directions of the IS academics. Consequently, the nature of the IS curriculum as well as the research directions taken by the faculties across the universities differ substantially. It can be concluded that IS discipline in Singapore has a high degree of professionalism.

- *Scientific reputation is high.* The administrative placement of IS within National University of Singapore and Singapore Management University, and the fact that the dean of the Nanyang Business School was an IS academic, combined with the evidence from the interviewees, suggest that IS is a socially recognized discipline that is distinct from traditional computer science on one hand, and from business on the other. In addition, prominent IS researchers are also serving on many national level planning committees.

- *Standard of competence and skills is well-established.* The quality of research, the level of output, and the research methods employed by IS academics in Singapore universities suggest that IS academics in Singapore are highly competent and competitive. It is therefore safe to conclude that standards of research competence and skills within the IS community in Singapore have been established.

- *Lack of a unique symbol system.* In contrast to the evidence above that points to IS being a distinct discipline from Whitley's theoretical viewpoint, it appears that while there is no problem in terms of communication within the IS community, there is a lack of a unique vocabulary or symbol system that excludes outsiders. This is common across the three universities regardless of their administrative placement.

In conclusion, using the Whitley's theory as a framework for defining a scientific discipline, there is strong evidence to suggest that the IS discipline in Singapore is indeed a distinct scientific discipline.

XII. IMPLICATIONS AND LIMITATIONS

Two implications could be drawn from this study. Firstly, having annual surveys to assess the state of the Infocomm industry and the manpower requirement (conducted by the Infocomm Development Authority of Singapore) and using the finding from those surveys have helped the IS institutions in Singapore understand and keep up with the changing needs of the industry. Other countries with similar regulatory bodies could perhaps adopt a similar model, and, if not, perhaps the leading universities in that country could spearhead such an initiative. Secondly, while a regulatory body exists, it does not place any restrictions on the type of research that the IS researchers could undertake. In addition, there appears to be no restriction within each institution regarding neither the number nor nature of the research areas or "groups" that the faculty must be aligned with. This creative freedom appears to work well for Singapore, particularly in the case of the National University of Singapore, whose IS research is ranked among the top, not just in Asia but worldwide as well [Huang and Hsu 2005]. Universities that imposed boundary restrictions and find such arrangements did not yield positive outcome could perhaps benefit from understanding the Singapore universities approach.

This study has several limitations. First, only the head of the discipline in each university was interviewed. While these interviewees are best able to provide the necessary evidence for the

study purpose, a more-thorough investigation, particularly from a historical viewpoint, could have been sought from other IS researchers, such as those that were cited as being the key figures in starting the IS discipline. Second, to fully test Whitley's theory, it would be useful to seek the views of the academics from other related discipline (such as business and computer science) to determine their perception of IS as a distinct discipline. Nevertheless, this study, being the first to examine the state of IS discipline in Singapore, has provided some ground works for future research, which could seek not only to address these limitations but also to inform a wide audience on the state of the IS discipline in Singapore.

ACKNOWLEDGEMENTS

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that:
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APPENDIX I. THE OVERARCHING STUDY:
THE STATE OF THE INFORMATION SYSTEMS ACADEMIC DISCIPLINE IN PACIFIC ASIA

Figure A-1 depicts the main components of the study "The State of the Information Systems Academic Discipline in Pacific Asia." The Pacific Asia study is motivated from a recognition that Information Systems as an academic discipline has evolved differentially around the world. The genesis of the study was a panel of the 6th Pacific Asia Conference on Information Systems (PACIS'02), Tokyo, Japan, ultimately resulting in formal project commencement in 2004 with AIS endorsement and seed funding.

Principal of the several related sub-studies is a series of case studies across the States[1] of Pacific Asia. The overall study has from the outset been designed and executed with the expectation that it would be extended and repeated over time. It was decided early on to restrict

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[1] The term "state" is used to refer to each of the national entities studied.

the first iteration of the study to those areas in the region where IS is relatively more visible internationally – Australia, Hong Kong (China), Korea, New Zealand, Singapore and Taiwan.
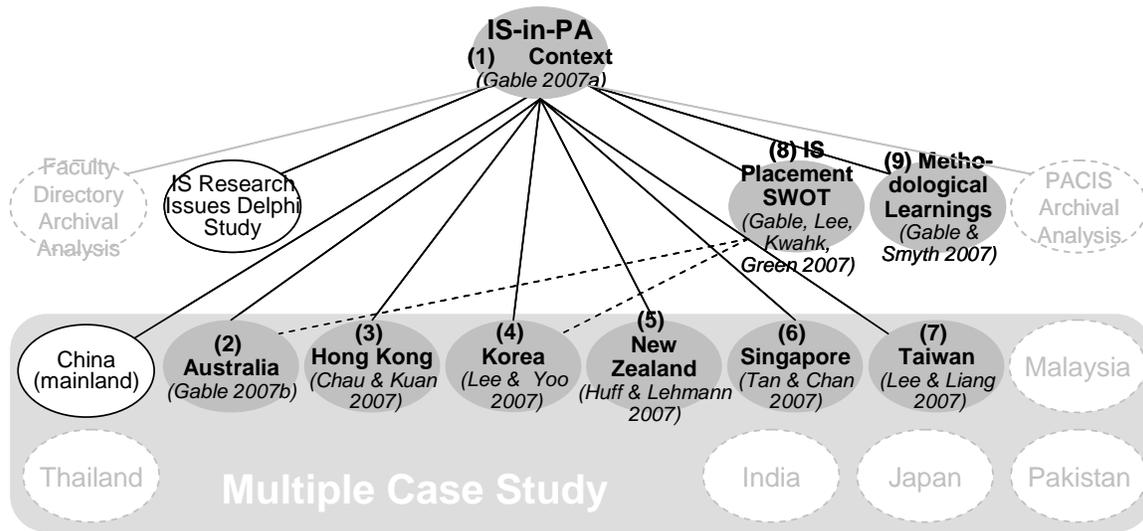

Figure A-1. The IS in Pacific Asia Region Sub-Studies

Shaded ovals in Figure A-1 represent those components completed in the first execution, with results reported in this special issue of CAIS. Unshaded ovals represent components in progress (i.e. Mainland China Case Study), and dashed ovals represent components soon to commence.

The largely exploratory and descriptive State case studies employed a common research framework [Ridley 2006]. The framework considers the current and past state of IS in Pacific Asia universities from the perspective of the development of a discipline. The framework was guided by Whitley's Theory of Scientific Change [1984a 1984b]. It suggests that there is an inverse relationship between the impact of local contingencies and a discipline's degree of professionalism and maturity.

Given the descriptive and exploratory character of the overall study, the team harboured no illusions regarding the ultimate completeness of issues to be
identified, related evidence to be gathered, and analyses to be conducted. It was acknowledged that the study offers a mere starting point for ongoing monitoring of the state of IS in the Pacific Asia region. Regardless, efforts were made to achieve some level of representativeness of the evidence and perspectives reported: (1) Selection of the study team – sought region-wide representation. This suggested state-based case reports. Senior and well known IS academics were approached. (2) Interviewees received an early draft of the state report in which their views were recounted. On the basis of feedback, changes were implemented by the state teams. (3) Selected "within state" local experts were sent a copy of the draft state report for review, aims being to: minimize potential adverse reaction from perceived misrepresentation, try to ensure the report is as representative of the state as possible, enrich the report with further insights, and ensure the process of peer-review results in papers of strong academic standard. (4) All authors on all papers of the special issue reviewed the complete draft special issue.

ABOUT THE AUTHORS

Bernard Tan is Professor and Head of the Department of Information Systems at National University of Singapore (NUS). He has previously served as Assistant Dean in the School of Computing at NUS. Dr. Tan received his Ph.D. degree (1995) in information systems from NUS. He has been a Visiting Scholar in the Graduate School of Business at Stanford University (1996-1997) and the Terry College of Business at the University of Georgia (1992). Dr. Tan is serving

on the editorial boards of *MIS Quarterly*, *Management Science*, *Journal of the AIS*, *IEEE Transactions on Engineering Management*, *Journal of MIS*, *Information and Management*, *Journal of Global Information Management*, and *e-Service Journal*. He has served or is serving on the program committees of many international conferences in the field of information systems. He has served as a Region 3 representative in the AIS Council.

Taizan Chan is a senior lecturer at the Queensland University of Technology. Dr. Chan received his Ph.D. degree (1998) in information systems from National University of Singapore. He has been a visiting scholar in the Wharton School of Business at University of Pennsylvania (1995 and 2001) and Haas School of Business at University of California, Berkeley (2004). E-mail address: t.chan@qut.edu.au

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