PROJECT MANAGERS AND TECHNICAL CHANGE: CURRICULUM DEVELOPMENT IN STRATEGIC TECHNOLOGY MANAGEMENT

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Abstract: Traditional business approaches do not take account of the rapid technological developments underpinning today's world. Further understanding the role of technology and its efficient management to build and maintain a competitive edge in business can allow project managers to more successfully manage organisations, and to adapt to and capitalise on, today's rapidly changing environment. Strategic Technology Management links engineering, science and management principles to identify, choose, and implement the most effective means of attaining compatibility between internal skills and resources of an organisation and its competitive, economic and social environment.

This paper reviews the rationale and the development of a new Strategic Technology Management subject in QUT's Master of Project Management program. It discusses recent developments in the area of technology management from an international perspective, provides details of the curriculum developed and discusses the experience of completing two years of teaching the new program.

INTRODUCTION

More effective use of engineering and science skills is essential if Australia is to develop the industrial structure necessary for economic growth. This requires technological and multi-skilling of our engineers and scientists, a balance of skills—

technical and managerial—with a finely developed social awareness of the impact of their decisions on industry, community and environment. This statement by Kim Beazley (1992) as the former Minister for Employment, Education and Training provides direction to the path required of Australia's technical managers.

A range of authors have recently identified the need for greater management focus on technology management. For example, *Australia's engineers are well prepared in engineering technology, but not as well prepared for the full practice of engineering and business dimensions. ... Specialists—like managing engineers and scientists—must also have broader and non-technical skills, and the capability to perceive the wider opportunities provided by technology so that possibilities can be turned into commercial products.* (APESA, 1992, p8, 16). Also Clark (1989, p96): *Managers need to link the world of technology with the world of business*.

The importance of the link between the technology and appropriate management in the organisation is described by Scott (1994, p55): *Often technology is applied at the enterprise level as a productivity driver without attention to the other attendant issues of organisation, competence and work force commitment. Consequently, the benefits of technology are curtailed.*

Given the range of projects that modern project mangers can be called upon to manage, it seems clear that an introduction to the management of technology should be included in the Master of Project Management program. The following section describes current academic trends in this area.

BACKGROUND

International Perspectives

Internationally, a number of authors have advocated management of technology as a necessary adjunct to both commerce and technical faculties in tertiary institutions. For example, Collins et.al. (1991) highlights the challenges facing European industry from global competition and urges a more effective management of the exploitation of technology and the way it is used to introduce new products and processes.

Organisations need to acquire the ability, to not only generate innovations internally, but also to assimilate the impact of external innovations. The world-wide competitive economy, the rapid pace of technological change and diversification and decentralisation of business place greater pressure on the management aspects of technology in the 1990's. They define technology management as *the design and use of the means needed within organisations to achieve economic and social objectives through technological innovation* (p571).

Through a series of research interviews and questionnaires with a wide range of engineering and technological companies in the UK, Collins et.al. explored executives' perceptions of how management would handle problems arising in the wake of the adoption of new technologies. This also identified training for the technology-management interface. The conclusion emerged that technologists, although enthusiastic and dedicated, exhibited naivety in their approach to work which led to the creation of a new technology rather than the creation of a business opportunity.

Collins et.al. (1991) proposed a two-phase remedy for this identified shortfall, the first being postgraduate experience in industry and training designed to produce operational competence at junior to middle management levels in the organisation. The second phase of professional development was to encourage these middle level managers to think like top management. Higher education programs designed to achieve this second goal they called "technology management courses". The emphasis here lies on *strategic* rather than on *operating* issues. The authors then went on to propose a series of subjects for these courses.

The New Zealand experience reported by Kirk (1994), is based on an industry study on the prevalence of technology strategies—an outcome of effective technology management. Only 33% of key New Zealand firms surveyed had a formal technology strategy—*low by international terms* (p2). The study also found that many of the firms that acknowledged such a strategy often confused this with managing the development of products and processes rather than a genuine commitment to long run exploitation of technologies for competitive advantage.

Subsequent research (Kirk, 1994) reviewed the qualifications of senior management board members in New Zealand firms. Non-technical qualifications dominated, with only 6% of board members from New Zealand's top 200 companies comprising technically-trained professionals. Kirk (1994) also provides information arising out of a survey on individual senior management needs and attitudes. These needs were not traditionally covered by "general management programs" and included such topics as:

- assessing and evaluating technological options
- managing technical people and teams
- the strategic role of technology
- technology project management
- technology transfer and legal issues
- managing change and technological innovation.

In the United States, the Construction Industry Institute (1992, p22) reviewed the nature of building construction projects and future competition and reported: *The responsibilities of upper management by the year 2000 will likely be focussed toward: providing a working environment that stimulates innovation and caters to the needs of employees. ... To remain competitive at the turn of the century, creative and innovative ideas to improve productivity must also be explored. Innovation is a key for obtaining a competitive advantage in any industry. For innovation to take place however, an environment that stimulates or encourages new ideas must be created, and this remains the responsibility of management.*

QUT School of Construction Management Initiatives

Following a review of the Master of Project Management program in the School of Construction Management program at QUT in November 1994, a series of progressive modifications were made reflecting international trends coupled with industry and student input. One of the enhancements was offering a new subject—CNP400: Management of Technology—as an elective for both the Project Management and Property Development majors.

This subject provides Project Managers with a theoretical foundation and a set of tools and concepts to improve the efficiency and competitiveness of technically oriented

organisations. It builds from a theoretical base and progresses to practical applications and management tools. The unit includes the following topics:-

- Technology and competitive advantage
- Technological trends and forecasting
- Invention, innovation and commercialisation
- Strategies for product development cycle time reduction
- Acquisition of technology
- Human skill component of technological capabilities
- Managing the technical function
- Role of the manager as leader, champion, motivator, and facilitator.

Appendix A includes the complete synopsis for the subject, including assessment details.

OUTCOMES TO DATE

Management of Technology has been successfully integrated into the QUT Project Management postgraduate program, with most first year students electing to enrol in this subject. To date, two semesters of study in Brisbane have been completed, and two concentrated formats in the QUT School of Construction Management's offshore classes in Singapore. Student feedback has been very positive with clear recommendations for future maintenance of this subject. The School of Construction Management has now also proposed that this subject form one of two common subjects available across the entire Faculty of Built Environment and Engineering for proposed generic Built Environment and Engineering Masters Degrees.

From a learning perspective, the provision of the theoretical background followed by applied case studies is the preferred mode of teaching. Unit objectives are achieved through an integrated blend of lectures, specialist guest presentations, case studies, class discussion, reading and assignments. Learning through group participation has been shown to be a highly effective method of graduate education. Therefore, working in teams forms an important component of this subject. Where possible, multi-disciplinary and multi-cultural teams are encouraged. The postgraduate students are expected to

bring to the class ideas, views and a willingness to be actively involved in their own learning. Feedback from this series of learning experiences has been enthusiastic, with the following comments recorded from Brisbane-based students on the QUT Student Evaluation of Teaching proforma being typical, *"Good subject, very relevant, enjoyable and stimulating,"* and *"Case study method is an excellent process."* Singapore students have also embraced the concept of this approach and commented, *"Case studies are excellent—they stimulate thinking and encourage participation,"* and *"Lively teaching and intermingling with class allows students to have greater interest in the subject."*

In the first offerings of this subject during 1995 and 1996, case studies from the Stanford Graduate School of Business and Harvard Business School were used. QUT has now supported the development of Australian case studies for technology management through their internal Teaching and Learning Grants Scheme. Industry collaboration through student groups (comprising middle to senior managers) is being used to develop quality documented case studies, including video support. This funding will provide the resources to have the case studies refined to a standard for publication as professional learning tools. No other collection of Australian cases is known to exist in this emerging management of technology area.

Assignments completed to-date have been professionally presented and provide student groups access to key local companies to review leading edge product or process development. Current topics for this assignment in 1996 include: Architectural technology in roofing explosive store houses, Fruit and vegetable packing and transportation system, Electronically operated hands-free doors for the disabled, Flatpack plywood design lighting, Robotic head boning machine, Electronic hotel guestroom control system, Curtainwall systems for commercial buildings, Precast concrete building elements, and Computer-based electronic developments.

These assignments and class discussions have been very successful in encouraging students to analyse the internal skills and resources of an organisation and its competitive, economic and social environment. The learning experience for the students, and the participating firms, has been very positive. Current research is

evaluating student and industry perceptions of the outcomes of this new subject introduction to enhance its future content and delivery format.

CONCLUSIONS

Better understanding the role of technology and its efficient management to build and maintain a competitive edge in business can allow project managers to more successfully manage in today's rapidly changing environment. Strategic technology management links engineering, science and management principles to identify, choose, and implement the most effective means of attaining compatibility between internal skills and resources of an organisation and its competitive, economic and social environment.

This paper reviewed the rationale and the development of a new strategic technology management subject in QUT's Master of Project Management program. International trends and the pace of technical change require that managers of technical organisations manage technology in the context of the overall business environment. Details of the multi-disciplinary curriculum developed at QUT was provided, including a sample of the subject outline. The experience of completing two years of teaching the new program in Australia and in South East Asia has proven to be a positive learning experience. Plans are now in hand to increase the subject weighting within the masters program and to expand the delivery options of this material to focussed industry and professional development programs.

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QUEENSLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF CONSTRUCTION MANAGEMENT

**PROJECT MANAGEMENT
GRADUATE PROGRAM**

**SUBJECT UNIT CNP400
MANAGEMENT OF TECHNOLOGY**

AUTUMN SEMESTER 1996

MONDAYS 7:00PM TO 9:00PM

ROOM L418

**DR KEITH HAMPSON
Phone: 3864-2288 Room: L429
Email: k.hampson@qut.edu.au**

February 1996

1.0 SUBJECT UNIT OVERVIEW

This unit introduces key concepts and furthers the understanding of the role of technology and its efficient management to build and maintain a competitive edge in business. Management of technology links engineering, science and management principles to identify, choose and implement the most effective means of attaining compatibility between internal skills and resources of an organisation and its competitive, economic and social environment. This subject provides managers with a set of concepts and tools to improve the competitiveness of their organisation.

2.0 OBJECTIVES

The major objective of this subject is to educate students in the concepts and application of the management of technology. The subject will examine:

1. Technology and Competitive Advantage

Opportunities for integrating the company's technological resources into an overall technology strategy, interactions between operational functions, development of organisational capabilities to encourage and support the realisation of technology-based opportunities and investment in technology.

2. Technological Trends and Forecasting

Technological trend forecasting techniques to assist in identifying potential new development and opportunities, evolution and revolution in product and process technology, invention and innovation, advanced manufacturing processes, product development cycles.

3. Acquisition of Technology

Internal and external sources, individual and joint research, strategic alliances for technological development, managing the transfer of technology within and between organisations, the human skill component of technological capabilities, learning across projects.

4. Managing the Technical Function

Integration of technical management responsibilities into the business, organising technical resources, project management, managing technical staff, strategies for cycle time reduction, enhancing internal capabilities through organisational learning, role of the manager as a leader, champion motivator, and facilitator.

The subject unit objectives will be achieved through a blend of lectures, case studies, class presentations and discussion, reading and assignments. Other related and important objectives of this unit are to encourage students to work effectively in multi-functional teams and to improve their analysis and presentation skills - important attributes for professional project managers.

3.0 LECTURE OUTLINE - PRELIMINARY

Note: A more detailed outline indicating actual cases and dates for team presentations will be provided in Week 3 when actual class numbers are known.

Week	Date	Topic
1 case	12/02/96	Overview of subject unit, assignments, assessment and study methods.
		Introduction to technology and competitive advantage.
2	19/02/96	Technology and competitive advantage.
3	26/02/96	Technology and competitive advantage.
4	04/03/96	Technology and competitive advantage.
5	11/03/96	Technological trends and forecasting.
6	18/03/96	Technological trends and forecasting.
7	25/03/96	Technological trends and forecasting.
8	01/04/96	Acquisition of technology.
		MID SEMESTER BREAK
9	15/04/96	Acquisition of technology.
10	22/04/96	Acquisition of technology.

11   29/04/96   Managing the technical function.

12   LABOUR DAY

13   13/05/96   Managing the technical function.

14   20/05/96   Managing the technical function.

15   27/05/96   Subject review and conclusion.

4.0 ASSESSMENT

Case Study Presentation	35%
Assignment	40%
Class Participation	25%

4.1 Teams

Learning through group participation has been shown to be a highly effective method of graduate education. Working in groups or teams will therefore form an important part of this subject.

Students should form teams of four or five and nominate these to me in writing with your (original) group name by Week 3. To maximise the benefit of working within teams, you should ensure that a mix of professional and cultural or national backgrounds exists.

4.2 Case Study Presentation

A series of case studies will be used throughout the subject as an integral component of the learning process. Developing personal skills in formulating, evaluating and recommending management actions is an important dimension of the Project Management program.

Depending on actual student numbers, approximately five nominated cases will be analysed by one student team each week. Professional presentations to communicate clearly, concisely and powerfully (using appropriate audio/visual aids) will be made to the class. A hard copy of the group's analysis and transparencies is to be submitted together with the software file (preferably in Microsoft PowerPoint). Time allotted for presentation is 30 minutes followed by approximately 20 minutes of

class questioning. The specifics of the case presentations will vary according to the individual cases.

At least two designated members of each team will present the team's problem diagnosis, plan of action, highlights of the supporting analysis and a "reality-test" - an assessment of the most likely risks or pitfalls in implementing the team's plan. Since the rest of your class colleagues will have also analysed the case, the presenting team should avoid simply regurgitating case facts on the slides. Your presentation should show the new information your team has created in its analysis.

After the team presentation, the discussion will be opened to the rest of the class. As a group, we will build a more complete analysis of the situation. The final portion of the class may be a discussion of concepts and techniques brought out in the case but useful in a broader range of situations.

Assessment for the group presentation will be based on the overall professionalism of the presentation, and the content and rigour of the case analysis - in equal proportions.

4.3 ASSIGNMENT

For the major assignment, you have the choice of completing one of two types of projects as outlined following. With either project you should work in your teams.

Option 1:   Development Project Audit

You identify a specific product or process development project in a local company and do an audit and analysis of that project and the company's process for managing it.

By focusing on a specific product or process development, I believe that a series of three or four personal interviews will enable your team to gather the required data. You will need to meet as a group in advance of those interviews to outline your approach and focus. Naturally, you will also need to meet after the series of interviews to structure your analysis and conclusions and to prepare your report.

Option 2:   Comparative Evaluation of Two Companies

Prepare a comparative analysis of two technology based companies which are direct competitors. Your goal is to understand the reasons that one has emerged into a stronger position than the other over a period of several (5 to 15 years). You should select companies which at one time were relatively equal in strength, or situations in which a newcomer has outperformed an entrenched competitor.

This project will involve library research rather than substantial fieldwork. Sources of information include company reports (such as annual reports), articles and announcements in the business press (e.g. Financial Review, The Australian, Wall Street Journal, Business Week) in the trade press and in financial reporting services (e.g. Standard & Poors Industry Reports). You should carefully document each company's financial performance, strategy, product introductions, and management methods.

There are many theories why one company succeeds where another does not: better people, better products, better timing of product introductions, cost advantages from the "experience curve", historical accident, diversity in management backgrounds and characteristics, stability in management, better management methods, leadership of the top manager, better incentives, better overall strategy, better execution of strategy, better fit among market needs/strategy/organisation, more adaptable, faster moving, more able to learn. You should consider which

of these theories may apply to your companies, and whether a particular combination of them lies behind their success and failure. Alternatively, you may be able to eliminate all but one or two items as explanations of success and failure.

Comments Applicable to Both Options

You should form your group, select your company(ies), and prepare a one page proposal and work plan to be submitted by Week 4. This work plan should outline what you intend to accomplish, how you are going to go about doing that, and what the output of that project will be (chapter headings are recommended here). You will also need to outline a timetable for your project. As a guide, I suggest that the final report be no longer than 15-20 pages typed double-spaced, excluding exhibits. This report will be due in Week 11, i.e. by 29/04/96. All members of the project team will receive the same grade unless a written authorisation suggests that I do otherwise.

Exhibits should contain specific types of analyses such as financial analysis, break-even charts, cost analysis, product maps, competitor analysis, etc. In general, exhibits should contain any information that supports and is relevant but would be too detailed for the body of the paper. Exhibits should not simply be an extension of the text.

Please type and proof-read all your papers. The submissions should be of the same quality that you would provide to the management of a business with which you were dealing professionally. A complete 'hard" (paper) and electronic file copy (preferably in Word or WordPerfect format) is to be provided. Use these projects as opportunities to hone your written communication skills.

Assessment for the assignment will be based on the overall professionalism of the submission, and the content and rigour of the

project analysis - in approximately equal proportions. Late submissions will be assessed at 5% less of the available mark per day after the due date (eg, if 7 days late, the maximum grade will be 100% - 7 x 5% = 65% of the possible maximum mark).

4.4 Class Participation

As post-graduate students, you are expected to bring to the class ideas, views and a willingness to be actively involved in your own learning. To achieve maximum benefit from this subject, you will have to study the assigned reading materials prior to each class and be prepared to discuss the cases and your industry experiences in class. The success of your management career will depend critically on your verbal skills. The classroom should be considered a laboratory in which you can test your ability to present your ideas clearly to your peers. Some of the criteria I will use to judge the effectiveness of class participation includes:

1. Are the points made relevant to the current discussion? Are they linked to the comments of others?

2. Do the comments show clear evidence of appropriate and insightful analysis of the case data or your experiences?

3. Is there a willingness to participate?

4. Is there a willingness to test new ideas, or are all comments "safe" (in providing generic statements that repeat the background reading or case facts without analysis)?

5. Do comments clarify and highlight the important aspects of earlier ideas and lead to a clearer statement of the relevant concepts and issues?

The questions accompanying the cases and readings are intended to help you prepare each case, but they should serve only as a starting point. The intent is to get you moving down the right path, not to limit the scope of your analyses and explorations. You should decide what the key issues are and how they can be best addressed.

Please be prepared for every class since I will also call on individuals whose hands are not raised.

I will learn your names as quickly as possible, but I do ask that you use a name card, and I will pass around a seating chart during the second class session. Please select a seat for that second class that you would like to sit in for the rest of the semester.

5.0 REFERENCES

There are no specified texts for this subject. I will compile a series of reading and case studies and make them available either in the lectures or through the Bookshop. The following list of references will aid your learning and assist in your assignments.

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