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“I certify that this work is entirely my own and has not been accepted as part of a submission to another degree course”

Signed: ..................
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ABSTRACT

There is a need to research the processes of educational change in Singapore as rapid changes can result in complex problems. This is a study on academic staff's responses to an educational change in an engineering School in a Singapore University. The theoretical framework of this study is based on Etzioni and Lehman's (1980) exposition that organizational factors are important in studying educational change and Blenkin's et. al. (1992) theory of beliefs about change. Perspectives of change in Singapore, particularly the academics', were analyzed, using Blenkin's et. al. (1992) description of the different attitudes towards change. Schon's (1971) model of dissemination of change was also used in the examination of how this change was implemented.

Previously, students undertook one year of common engineering curriculum when they enrolled in a Bachelor of Engineering program in this University. This has, however, been expanded to a two-year common engineering program. This study examines the academic staff's responses to a change from one year to two years common engineering in a Bachelor of Engineering program. Along with this change is an attempt to broaden the engineering curriculum of the Bachelor program. This study investigates the organizational factors that influence the academics' responses to the curriculum change, and how they implemented the planned change in their teaching practices. Semi-structured interviews were carried out with 10% of the academic staff in the Engineering School in this University. The interviewees concurred on the points that more channels should be provided for them to communicate their views on the curricular issues in the University, and that top-down decisions should be incorporated with bottom-up input. In addition, focus group discussions were carried out with 5% of the student population enrolled in the two-year common engineering program. Documentary analysis was also carried out in this study. A number of the University's publications on the rationale of this change as well as newspaper articles were analyzed. This study discovers that more attention should be paid to students' learning, particularly in developing attitudes and skills that will help them adapt to a knowledge-based economy and rapid economic developments. In general, the academics in the present study held an attitude of change that is reflective of Blenkin's et. al. (1992) description, that change is inevitable, and survival entails adaptation to this change. They felt, however, that educational changes were too sporadic and frequent, consisting of reactions to external changes, particular in the area of economic changes. They desired a greater and deeper involvement in decisions on curriculum changes so that they could contribute their professional and pedagogical viewpoints. This study shows, therefore, the importance of examining the factors that influence academics to change and the stages they go through. It also shows the need to involve academics at every stage of a curriculum change.
CHAPTER ONE
INTRODUCTION

1.1 Introduction

This chapter provides an introduction to this research undertaken to examine academics’ responses to a curriculum change in a university in Singapore. It gives the background to this research by describing briefly its context, theoretical assumptions and research aims. It also provides a forecast on what is covered in the following chapters by describing briefly the research methods and limitations of this study. This chapter aims to be explicit about the purpose of this research, both in terms of what it seeks to find out and the usefulness of this information to educators in Singapore.

1.2 Research Problem

In making educational changes, it is always a difficult task to balance between meeting national economic needs and needs of academic staff as well as students. In a situation where educational changes are introduced at a rapid rate to keep up with rapid economic changes, it is easy to overlook the viewpoints of academic staff. As such, it is important to find out how the academic staff think about, respond to and implement educational changes.

Academics in Singapore have to cope with rapid changes in the educational system. The economic growth of Singapore is dependent on her human resources since she does not possess natural resources. This makes education one of the most important considerations of the government. Much effort is devoted to planning the curricula to ensure students are trained in relevant skills for the workforce as well as to maintain economic progress. Singapore’s economy has been dependent on the global economic situation. As a result, the government is concerned with global changes and how it can
compete internationally. With globalization, Singapore also faces unpredictable economic changes. It is now crucial to prepare a workforce that can face the challenges of uncertain job market and demand for different skills from those of the past. Consequently, constant adjustments are made to the education system which is a key element in training and preparing the workforce for such economic changes. At a national level, since 1985, the government in Singapore started to give more autonomy to educational institutions to appoint staff and devise their curricula in a quest for creativity and innovation (Tan, 2003). It is important to develop creativity and flexibility in students in order to Singapore's economic competitiveness in the global market (Tan, 2003).

Academics face a number of problems resulting from such rapid educational changes. Much pressure is placed on the teaching staff to make adjustments to their curriculum and teaching. Sometimes, when changes happen too fast, teaching staff may resort to making superficial changes to comply with the demands of curriculum planners and no in-depth change happens to their teaching approaches. In addition, they may not be able to adapt fast enough to such changes and may be unaware of the goals as well as desired outcomes. Educational wastage can also result when much time is spent on planning these changes yet teaching approaches and students' learning do not change. This is especially true when there is inadequate preparation for teaching staff to make the needed adjustments. Thus, there is a need to study teaching staff's perception and adaptations to educational change.

Academics are also often not involved in the evaluation of educational changes. In Singapore, there is an overriding concern with measuring the outcomes of educational change. Quantitative external criteria are often used, without due consideration of the contexts of the particular institutions or departments. It is inappropriate to employ evaluation procedures based on the effectiveness of the
program in terms of set standards or criteria (Kemmis, 1983). An examination of the educational change is dependent on context and people in the institution. The effects of educational change on members and their views should be explored. This may not be possible if examination was carried out using a top-down approach of measuring outcomes.

Therefore, this study seeks to find out how organizational factors affect academics' responses to a curriculum change. The university is chosen as it is at the forefront of the government's strategy for economic planning. The institution selected for this study is Nanyang Technological University. It is also hoped that through this case study investigation of curriculum educational change of this University's Engineering School, the importance of considering people's situations and their roles in the educational change can be highlighted. Kemmis (1983) explained that individual participant perspectives are important as educational changes depend on the participants' personal commitment. This characteristic of educational change means that examination of change has to be based on 'negotiation, deliberation and diplomacy' (Kemmis, 1983).

The subject matter of this research is the curriculum change made at the School of Electrical and Electronics Engineering, Nanyang Technological University. It is hoped that this study will benefit decision-makers involved in planning the curriculum whether within the university or at higher levels, with the Ministry of Education or other organizations. This study therefore seeks to examine educational changes in terms of how the school introduces changes to its curriculum in response to external economic changes and academics' perspectives of these changes.

The theoretical presuppositions that this study adopts follow the claims made by Blenkin et. al. (1992), Etzioni and Lehman (1980), Taba (1962) and Reid (1978). Their theories will be discussed in greater detail in Chapter Three. This study seeks to
examine three broad areas regarding organizational factors that affect academics’ responses to a curriculum change, namely, the context of the change, involvement of academics in decision-making and processes of the curriculum change, and lastly, communication of the change from top to bottom levels of the university. These areas are identified because it is predicted that in a situation where a change is made by the people at the top, by government or policy-makers, that involvement of, and communication with, the academics will be the central issues in the process of implementing the change. Literature searches in Singapore have failed to discover any research on educational change. Educational change is therefore a crucial topic of research in Singapore considering the lack of studies on it and the fast rate in which it occurs here. Studies done in other countries are quantitative rather than qualitative in nature. They also focus on surveys done with large groups of academics on areas predetermined by the researcher rather than in-depth examination of what the academics feel about educational change. Case study provides an opportunity for an in-depth study of what academics go through in educational change. It allows for an examination of academics’ understanding of a curriculum change, their implementation of it, influence on the students’ learning outcomes and ultimately, the desired goals of the educational change. This study therefore aims to examine how organizational factors affect academics’ responses to a curriculum change.

The objective of this study addresses the following questions:

1. How do organizational factors influence academics’ responses to curriculum change?

2. How do academics respond to the curriculum change?

3. How do the academics work together to implement the planned curriculum change?

4. What changes they make to course structure and teaching?
5. How is students' learning changed?

In addition, it is important to examine curriculum change for two reasons. Firstly, educational changes are often introduced without consideration of objectives or plans set in the original curriculum. Secondly, it is for the purpose of examining problems and benefits of the changes. There is very little study done of curriculum changes in Singapore, even at the level of higher education. In particular, there is very little study done on engineering education in Singapore. Lastly, it is important to examine the problems and benefits related to higher education and the economy. Such an examination of curriculum change will also help to reduce educational wastage; assess members' attitude, commitment and effects experienced from the change; examine the sustainability of the educational changes and gather lessons for future changes. This study is concerned not so much with the outcomes of the curriculum change, but the process of its implementation. It considers the views not only of policy makers, but academic decision-makers including deans, heads of divisions and teaching staff.

This section has therefore provided a synopsis of the objectives, purpose and context of this study. More complete accounts of these aspects are in the following chapters. The following sections describe briefly the theoretical assumptions, research methods and limitations of this study.

1.3 Theoretical Assumptions

The theoretical assumptions in this study are partly derived from Etzioni and Lehman’s (1980) claims that organizational factors affect members’ responses to change. Further elaborations are found in Chapter Three. Looking at the context of Singapore, this study also assumes that people hold a view of change that reflects Blenkin’s et. al. (1992) third perspective of change. This present study has been
influenced by Blenkin's et. al. (1992) theory of change in that it examines educational change as an inevitable aspect of coping with external economic changes. This research then goes on to find out how organizational factors affect individuals' responses to educational change, bearing in mind Etzioni and Lehman's (1980) claim that organizational factors affect individuals' responses to change. This theoretical framework then guides the research methodology undertaken in this study.

1.4 Research Methods

As this study is interested in in-depth examination of academics’ viewpoints and responses to educational change, a qualitative research approach is adopted. In this study the perspectives of practitioners, like academics, are important in examining educational change. This study is more interested in exploring the academics’ perspectives rather than predetermining these in the process of the research. For this reason, semi-structured interviews are used rather than surveys. It is through interviews that it is possible to find out how organizational factors affect the academics’ views and responses to the curriculum change, the problems they encounter and how they work together to implement the change. This research also seeks to examine individual's views rather than generalize the academics' viewpoints into a few statements. In addition, documentary analysis is used as a research method in this study, as it allows for a comparison between the aims of the policy-makers and the academics' understanding of the curriculum change. The qualitative nature of this study therefore leads to an examination of underlying attitudes, issues and responses that cannot be achieved with the use of quantitative method.

1.5 Scope of the Study
This study is limited to an examination of in-depth responses from academics to a change in an engineering curriculum. Due to the fact that its emphasis is on in-depth examination, interviews are done on 10% of the academics and 5% of the student population. Furthermore, this study explores only organizational factors affecting academics' responses towards a curriculum change. In this case, organizational factors are chosen for analysis as these can be changed and improved more easily, thereby influencing the teaching of the academics. The findings of this case study can also contribute to an accumulation of case study material on educational change.

1.6 Thesis Structure

This thesis consists of seven chapters. This chapter gives an introduction, describing the background, purpose and aims of the research undertaken. The following chapter describes the context that is essential in analyzing the findings. Chapter Three reviews the literature on the importance of a consideration of academics' views in educational change and provides a theoretical framework to this study. Chapter Four then describes the research methodology adopted in this study. It presents a defense of the methodology used by analyzing the strengths and weaknesses, as well as a justification, of the methodology in terms of the research objectives of this study. The findings of this research are presented in Chapter Five, and Chapter Six provides a discussion and analysis of these findings. The last chapter then draws the conclusions from the study.

The next chapter describes the development of educational system in Singapore and the motivation for educational changes. It demonstrates how the direction of educational development and changes is situated in the economic, social and political circumstances in Singapore, and aims to pave the way for national development.
next chapter also describes how decisions about educational changes are made and disseminated to the universities in Singapore.

An understanding of this context is important as research literature shows that educational changes must be studied in the contexts in which they occur. A comparison can then be made between the context of educational changes in Singapore and research literature on educational change covered in Chapter Three. Finally, an understanding of the contexts provides insights to the problems and tensions faced by academics in implementing and adapting to educational changes. This chapter has therefore outlined the research objectives, questions and scope of this study and the next chapter proceeds to describe the context, both in terms of national and educational factors of this study.
2.1 Introduction

Educational change needs to be examined and analyzed in the context of the political, social and economic situation of the country in which it occurs. It also needs to be studied in the context of the institution that it takes place in. The organizational structure of the educational institution is very much influenced by the political, social and economic factors of the country. This chapter therefore provides the historical background and description of the nature of educational changes in Singapore. In addition, it outlines in details the role of the university in national development against such landscape of educational changes. Lastly, this chapter explains the organizational structure of the University and School researched upon in the present study.

2.2 Historical Background of Educational Change in Singapore

In a small nation-state like Singapore, which does not have natural resources to depend on, the training of a skilled and diverse workforce for economic development is essential for her survival. In addition, pressure exists to keep up with developments in the global economic scene. These external factors have a serious impact in terms of the type and rate of educational changes that take place in all educational institutions in Singapore. At the forefront of all these changes lie the universities, which play a key role in training graduates with relevant skills and specializations to meet the demands of the market and allow for expansion of industrialization in Singapore. Such an urgency to meet external needs and keep pace with global changes mean that educational changes in these universities are also rapid as well as unpredictable.
Universities play a crucial role in the government’s plan to raise a skilled workforce as well as prepare the nation’s growth into a knowledge-based economy. The concerns of higher education in Singapore are to train a workforce to sustain economic growth of the nation, and enable the small nation-state to compete in the international market. In the response to Lord Dainton’s report on university education in Singapore, the Minister for Education explained that university education in Singapore has to expand to correspond with the expansion of the economy and the growing demand for a graduate workforce (Minister for Education, 1990). This shows that the primary role of the university is to serve the needs of the national economy.

The need to match the university’s curriculum to economic needs means that the university has to adapt its engineering curriculum to unpredictable trends in both the areas of economic and technological developments, as well as demands for engineers in the market. It is also faced with the problem of how the curriculum can be planned so to train students in other skills in the event that there is a shrinking demand for engineers. In Lord Dainton’s proposal, it was recognized that engineers need knowledge in subjects like technological economics, human management and industrial relations (Dainton, 1989). This means having to fit these non-technical subjects into a crowded curriculum that is already filled with different engineering courses. Such a situation also leads to constant changes to the engineering curriculum due to market demands of what engineers should know as well as a need to balance the technical with the soft skills in the training.

2.3 Context of Educational Change in Singapore

The pressure for educational change in Singapore comes from the external environment, in particular, the need to keep pace with global technological and economic change for the nation’s survival. Therefore, in Singapore, the task is to get
the educationists’ co-operation for changes that originate from sources outside the educational institution. Thus, one of the research questions of this study examines how aware academics are of the motivation of educational change in the University.

The education system in Singapore plays a crucial role in bringing about the political and social cohesion amongst the people. This also explains why the government is concerned with setting the curricular in educational institutions. Wong (1974) argued that educational changes in Singapore could be understood by looking at the history of the nation. In 1947, the Prime Minister of Singapore saw in education a way to reshape and restructure the society towards nation building (Wong, 1974). The larger national goals of education supersede the individual aims of education in terms of pursuit of personal interest and development. This shapes the direction of educational change in Singapore that places nation building as its primary goal. A key question examined in this study is whether academics are aware of this goal and the impact that this has on the outcome of educational changes.

Another issue concerning educational change in Singapore lies in the alignment of this goal with the educational practice in the university. The question is whether there are conflicts between what academics feel university education should be versus what happens in practice due to a need to meet national goals. In addition, are educational changes happening at a rate that is too fast for academics to cope? These are all issues that are examined in this study.

The motivation behind educational changes in Singapore is to keep pace with the growth of global economy. The urgency to improve education is a means for national economic competitiveness especially after the 1985-86 economic recession (Tan et al, 1997). Global changes are rather unpredictable and the question lies in how the university can plan or adapt its educational practice to such unforeseen changes.
This is one of the issues that emerged in this study and the academics and students interviewed described how they saw the university handle this task.

The forces driving educational changes in Singapore are therefore the development of the nation and global economic changes. This means that there is a considerable pressure on the educational system in Singapore to produce graduates who can survive in the changing economic landscape. This situation gives rise to certain characteristics of educational changes in Singapore which the next section will address.

2.4 Educational Change in Universities in Singapore

This section focuses on the development, philosophy and changes in universities in Singapore. It begins with the philosophy that governs the development of university education in Singapore, and moves on to discuss how the environment shapes and affects the patterns of higher education.

One of the research questions in this study concerns the source of the educational changes in the university. It is important to note that in Singapore, higher educational planning takes place at two levels, the nationwide level which involves the planning for the development of the entire higher educational system, and the level of planning of the individual higher educational institutions (Lee, 1983). These two levels interact closely and are interdependent since plans of individual universities have to be coordinated at the national level. Lee (1966) quoted Dr Toh Chin Chye, former Vice-Chancellor of the University of Singapore, who in his speech, said that the universities also stand in a tripartite relationship with the public bodies and private industry and exist to serve the interests of the community. Mok and Tan (2004) explicated the crucial role the government of Singapore plays in higher education, in the areas of reviewing its system and curricula, in order to cultivate students' creativity and thinking skills. This poses the question of how the university implements such
initiatives that come from the government and how it balances internal needs with such external demands.

From the beginning of educational development in Singapore, the university's crucial role in national development lies in the fact that human resource planning and educational planning are inextricable aspects contributing to the success of development plans in Singapore (Seah and Soeratno, 1979, Ashton et. al., 1999). From history to the present, the government has to balance the tensions produced by the shortage of manpower, on the one hand, and possible social unrest that can result from too large a graduate enrolment, or later graduate unemployment (Seah and Soeratno, 1979, Ashton et. al., 1999). It is therefore important that graduates are able to get jobs quite soon after graduation. In the early stage of economic development of Singapore, a disciplined workforce was needed for the extensive growth of labour-intensive industries (Ashton et. al., 1999). The government is therefore very much concerned with guiding students' intake and curricula in the University in order to maintain social harmony as well as economic progress. This situation affects the nature of decision-making in the university, especially with regards to curriculum change and its dissemination.

In addition, the government puts certain structures in place to ensure that appropriate changes occur in the university in a way that can fulfill economic needs of the country. Mok and Tan (2004) delineated the major stages in educational reforms of Singapore since the mid-80s. They explained that educational changes in the universities began with the setting up of the International Academic Advisory Panel. This panel consisted of scholars from international education institutions and community leaders from big corporations. Their task is to develop the teaching and research in the universities. From the recommendations of this Panel, the government began to review the universities' admissions policy and adopted a more flexible policy
The government also reviewed the curriculum design of the university education and adopted broad-based cross-disciplinary curricula (Mok and Tan, 2004). The emphasis is more on innovative ways of teaching and assessment that will inculcate in students creativity and critical thinking (Mok and Tan, 2004). One of the issues examined in this study is therefore how the curriculum change in the university deals with changes in global and national economy and how it is successful in cultivating in students the skills needed in the new economy.

In 1999, the Singapore government emphasized the need for Singapore to cope with the knowledge-based economy, highlighting the crucial role the educational system plays in this (Mok and Tan, 2004). In the knowledge-based economy, knowledge and information are changing fast, necessitating skills, creativity and entrepreneurship (Mok and Tan, 2004). Brown et al. (2001) wrote that in this knowledge-based economy, skills should not only comprise technical competences through formal education, but an ability to ‘learn how to learn’. He explained that the short life cycle of knowledge and skills makes it critical to grasp new information and skills (Brown et al., 2001). In such an economy, some jobs can become obsolete, whilst new jobs are created that demand a higher level of skills (Brown et al., 2001). The drive to meet external and national needs also means that Universities have no control over matters like student numbers, expansion of disciplines, or specializations within disciplines. It also means that the changes are irregular and unpredictable, and together with the fact that it is enforced from the outside rather than coming from within means that it is harder for members to have a sense of ownership of the change. One of the issues examined in this study is therefore the academics’ level of commitment to such educational change.

In addition, the organization of institutions, in particular, that of educational institutions, is also very much influenced by the political structure in the country. The
politics of Singapore, for example, is marked by dominance of a strong leadership and a decision-making process that is top-down. Such a management style has proven to be successful in bringing about economic progress as well as political and social stability. It would therefore not be surprising that this management style is perpetuated and preferred in educational institutions in Singapore. The bureaucratic model is therefore the dominant feature of educational institutions, whereby decisions are passed down from the top, and careful follow-up of these decisions can be ensured. The bureaucratic model also allows for checks and accountability of the employees. In addition, Singapore is a small nation with no natural resource. A central control of state affairs is therefore seen as necessary, so that the different sectors of the country can be managed to ensure survival of the nation. Education is seen as helping with economic progress, in terms of raising a group of trained and skilled manpower.

It is apparent, therefore, that the national context in the forms of political, social and economic needs, shapes the objectives and curricular of the university. Educational changes occurring in the university have to be studied within such larger national context. In the next section, we will move from this large national situation to focusing on the context of the University and the School involved in this present study.

2.5 Context of the University in the Present Study

This section describes the organizational structures of the University in the present study, its objectives and direction of development. It also outlines the organizational structure of the School of Electrical and Electronics Engineering which is the School researched upon in this study. A chart of the different positions of the academics is presented in Figure 1 (p. 20) so that their administrative roles within the organizational structure can be clearly seen.
2.5.1 The University’s Missions Statement, Goals and Direction and Objectives in Provision of Higher Education in Relation to Other Universities in the Country

The Nanyang Technological University was established in 1991 with the upgrading of the Nanyang Technological Institute and the merger with Institute of Education following a proposal from Lord Dainton, Chancellor of University of Sheffield (Ministry of Education, 1990). Lord Dainton’s proposal was that Singapore build two strong comprehensive universities, the National University of Singapore and the Nanyang Technological University (NTU), with them ‘competing and offering many subjects on their respective campuses.’ (Ministry of Education, 1990, p. 2). The Ministry of Education’s proposal was that NTU broaden its focus and subjects related to engineering be introduced in NTU and strengthened there (Ministry of Education, 1990).

Mok and Tan (2004) described the recent developments in the University as an attempt to develop it into a world-class university and expand tertiary education opportunities for its citizens. A main policy in this development is the review of undergraduate curricula to place more emphasis on creativity and thinking skills (Mok and Tan, 2004).

These two phases of developments mean that the University now has to review and broaden its engineering curriculum. The question is how this can be done and what courses to be introduced and taken out. This issue is complicated by the fact that no one knows for sure what skills will become obsolete or grow in demand in the new knowledge-based economy.
2.5.2 Organizational Structure of the University

At the top of organization hierarchy of the University is the governing body, namely the University Council which appoints staff and decides the terms and conditions of service (A Message from Within NTU-Nanyang Technological University, 1997). The highest academic body of the University is the Academic Board which manages the admission, examination, instruction and research in the University (A Message from Within NTU-Nanyang Technological University, 1997). It is made up of the president and academic personnel like the deans, vice-deans and heads of divisions of various Schools, as well as some elected members (A Message from Within NTU-Nanyang Technological University, 1997). The principal executive and academic officer is the president of the university, who is assisted by two deputy presidents, deans of schools, registrar, bursar, director of personnel, director of student affairs and heads of other administrative departments (A Message from Within NTU-Nanyang Technological University, 1997). The university is divided into schools which are headed by a Dean each, and each School is further sub-divided into Divisions (A Message from Within NTU-Nanyang Technological University, 1997).

There are two possible kinds of policy changes in the University, those that are government driven and those started from within the University (A Message from Within NTU-Nanyang Technological University, 1997). For the latter type, the staff and the students can initiate them though the suggestions usually come from the staff (A Message from Within NTU-Nanyang Technological University, 1997). Before changes to the policies are made, a committee is formed to conduct a study of the policy change. For matters related to broad policies, the decisions are taken up by the University Council (A Message from Within NTU-Nanyang Technological University, 1997). For
changes related to academic matters, an academic committee is set up to look into these changes (A Message from Within NTU-Nanyang Technological University, 1997).

It can be seen therefore that a curriculum change goes through a few rounds of discussions by different committees in the hierarchy of the university. Having described the university's overall structure, the next section describes the hierarchy of the School of Electrical and Electronic Engineering.

2.5.3 Organizational Structure of the School of Electrical and Electronic Engineering

The School is managed by a management team led by the Dean. This team consisted of Vice-Deans and Sub-Deans who were to complement the work of the Dean (E3 20th Anniversary Commemorative Publication 2001- Our Passage to Excellence). According to the School's Anniversary Commemorative Publication, the divisional structure allows the School to respond flexibly and adapt to changing economic demands and technological progress.' (E3 20th Anniversary Commemorative Publication 2001- Our Passage to Excellence, p. 57). There are seven divisions in the School, as reflected in Figure 1.
2.5.4 Changes Introduced in the University

An ongoing change introduced to the organization of the University, since 2001 is the formation of colleges as part of the University’s effort to integrate different Schools (New Dimensions of Learning – NTU Annual Report 2000-2001). The aims of this are firstly, to allow for greater autonomy of schools of related disciplines to pursue their unique goals, and secondly, to give students a broad and basic understanding of the fundamentals of engineering which are essential in the nation’s move towards a knowledge-based economy (New Dimensions of Learning – NTU Annual Report 2000-2001). All the students undergo a multi-disciplinary program in their first two years of study, after which they elect to pursue one of the following disciplines in engineering shown in Figure 2.

E3 20th Anniversary Commemorative Publication 2001- Our Passage to Excellence, pp. 54-55
2.5.5 Curriculum Structure and Changes in the Schools of Engineering of the University

NTU maintains an involvement with industry and business which is reflected in the requirement for students to undergo industrial attachment and collaboration with the industry and business to set up joint research and training centers (*Future Directions for the Nanyang Technological University*, 1991 and *A Message from Within NTU-Nanyang Technological University*, 1997). The engineering courses in NTU are designed to provide a balance between theory and practice with a heavy emphasis on fundamental engineering principles and applications (*A Message from Within NTU*, 1997). Students actively participate in engineering design, laboratory experiments and projects, workshop practice as well as in-house practical training in the second year, industrial attachment for 6 months in the third year, and projects in the final year (*A Message from Within NTU*, 1997). From 1994-5 onwards, the academic unit (AU) system was implemented in the University, the result of a few years of revision and improvement (*A Message from Within NTU*, 1997). The aim of this system was to provide greater flexibility to the students (*A Message from Within NTU*, 1997). In this
system the academic year was divided into two semesters of 16 weeks each, with 13 weeks allocated for lectures and tutorials (*A Message from Within NTU*, 1997). Each subject carries a certain number of AUs, and 1 AU represents one hour of lecture/tutorial per week, with the exception of laboratory or fieldwork which carries 1 AU for every three hours per week (*A Message from Within NTU*, 1997). There are three main categories of subjects: core subjects which are compulsory and forms 80% of total AU, and prescribed electives which are subjects for specialization and free electives which are subjects chosen to broaden students’ learning (*A Message from Within NTU*, 1997). This, therefore, provides an understanding of the number of subjects the students have to take and the studying workload they have.

### 2.5 Conclusion

This chapter has therefore provided the background to educational changes in Singapore. It has shown the value the government places on education. It has also described how the belief that educational changes are necessary to adapt to economic changes develops. The government plans educational changes and sets educational policies in a way that can bring about economic development in the country. Knowledge of this context is important in understanding the top-down approach in educational changes in Singapore. It also helps to explain the pressure faced by academics to cope with such changes.

However, research literature has shown that a consideration of both State’s and individuals’ needs are important in educational change. The next chapter therefore gives the literature research on the importance of a consideration of academics’ views in educational change; the organizational factors that affect communication of change to academics and other factors that affect academics’ change. How these theories relate to the context of Singapore will also be discussed in the next chapter.
CHAPTER THREE
LITERATURE REVIEW

3.1 Introduction

The political, social and economic circumstances in Singapore are the driving forces for educational change in the country. These factors as described in the previous chapter instill a sense of the inevitability of change in educational institutions. This chapter begins with a definition of educational change and curriculum change in particular. It then proceeds to cover three main areas: firstly, how organizational structures affect academics' role in educational change; secondly, how important academics' role is in the implementation process, namely, and thirdly, the difference between planned change and change in practice. In addition, it examines the gaps in existing research on educational change. Lastly, it provides a theoretical framework for a study on educational change by showing how the research questions of this study arise from the gaps in existing research.

The first two sections of this chapter show how the literature points to the importance of academics' involvement in academic change, though this is a missing area in research on educational change. The next two sections of this chapter review writings on the organizational structures of a university that affect academics' responses to curriculum change. The organizational structures of a university also have implications on the way the curriculum change is disseminated to the academics and thereby their involvement in the stages of this process. The subsequent section examines existing studies related to the present research and the gaps in research. Finally, the last section provides the theoretical basis of the present study. This chapter shows that the present study is located within existing research on educational change and how the research questions are derived from this as well as the gaps in existing research on educational change.
3.2 Academics' Role in Educational Change in the University

This section examines the definition of educational change and reviews what the literature says about examining change. Much of the literature on managing change in general, as well as educational change, points to the importance of considering members' responses. The question is: what kinds of responses do people have towards change, and specifically, how do academics respond to educational change? This section examines the nature of educational change while the next section discusses more specifically, curriculum change.

It is said that change is happening in higher education across the world at a very fast rate (Farnham, 1999 and Sanyal, 1995), and managing change in academic curriculum is ranked as one of the biggest management challenges for higher education (Boyatzis et. al., 1991). This shows that it is important to study curriculum change in higher education. Much of the forces motivating such change in the academic curriculum in higher education are external. This is mainly because higher education is seen as a facilitator of national competitiveness, economic growth, and sources of knowledge and technological innovation (Farnham, 1999), particularly in the case of Singapore, this is the driving force for curriculum change (Boyatzis et. al., 1991). In Singapore, it is vital to train the workforce adequately and appropriately to meet economic needs and ensure growth. Educational change is therefore considered to be essential and inevitable (Chapter Two, p. 11). As higher education is influenced by this urgency to meet economic needs, because it supplies professionals in the workforce, the question that this raises is how educational change affects academics.

The literature shows that the role of academics in educational change is crucial in higher education. Institutions of higher education are different from business organizations in that a top-down planning process together with strategic management will result in many problems and will be unsuccessful unless it is participatory in nature.
It is argued that academics are the primary product and service of the campus as well key personnel in the faculty (Rowley et. al., 1997). The question, therefore, lies in how a balance can be maintained between changes in university that are planned to adapt to external factors and academics’ voice. This issue is particularly important in Singapore where the government plays a large part in decision-making in universities (Chapter Two, p. 12). Rowley et. al. (1997) wrote that there is a discrepancy between views and practice concerning educational change in higher education. The question arising from this is how academics are treated in the implementation of an educational change and how much are they involved in this process.

Educational changes inevitably affect academics. Morrison (1998) described the characteristics of change as structural, systemic, and dynamic. It is a process occurring over time, rather than being a single event. In addition, it is a non-linear, multidimensional phenomenon, a personal as well as organizational matter (Morrison, 1998). Such a view of change means that it must be studied as a process rather than evaluated based on the outcomes. This issue deserves a lot of attention in Singapore where the universities are expected to carry out the government’s development plans (Chapter Two, p. 12). More emphasis needs to be placed on examining internal processes of educational change within the institution. However, the definitions of change given by Morrison (1998) identify the components of change but do not describe the relations between them, in particular, the relation between the organizational and personal aspects.

In addition, educational change involves time and commitment and it is important for educational practitioners to feel an ownership in the change. Ford et. al. (1996) described managing change as a cyclical process of examination and review, involving criteria such as direction, organization, processes and infrastructure.
Examination of educational change is particularly important in Singapore because change happens rapidly, and advancement of national development is the predominant concern of Universities (Chapter Two, p. 12). Fullan (1991) saw educational change as multi-dimensional that involves a change in practice. Secondly, managing change may be more than a simple task of utilization of human and material resources (Fullan, 1991). In the case of Singapore, therefore, where people are viewed as important resource for the country, it is important that academics and students are treated with more worth than simply resource. The act of influencing people's beliefs, values and practices so that they can embrace the principles of the desired change requires time and communication with people.

In addition to shaping attitudes and beliefs, educational change involves influencing social relationships. In education, change will affect social relationships since the product of education consists of students' learning, and the fabrication of the product, the interaction between teaching staff and students (Huberman and Miles, 1984). It is therefore important to examine students' learning resulting from an educational change. This is the case in Singapore where no study has been done on effects of educational change on people. Busher (1990) claimed that in examining educational change, it is insufficient to engage in a structural analysis of organizations as educational changes happen through a process of negotiation between people. Both of these claims highlight the point that educational outcomes are subjective as well as based on interpersonal relationships. The importance of such human factors in educational change certainly needs to be emphasized. Organizational structures, however, have an influence on the behaviour and relationships of members.

The literature on educational change therefore points to the need to study three aspects: organizational structures, teaching staff and learning outcomes of the students. The next section focuses the discussion on curriculum change.
3.3 Academics' Role in Curriculum Change in the University

In this section, the definition of curriculum and the nature of curriculum change are discussed. This section provides a framework for studying educational change by highlighting the aspects of curriculum change that are examined.

Writings on the definitions of curriculum point the need to review curriculum especially with regards to whether they meet objectives. A curriculum can be defined as a set of plans for learning and development, which includes not only the syllabus, but also important processes like planning, instructing, evaluating and managing (Limb, 1992). By virtue of such a definition, an examination of a curriculum should include its planning, execution and management. The objectives of a curriculum will be influenced to a certain degree by external needs and demands of society. Curriculum planning has been defined as the selection of knowledge to be transmitted to students and the principles by which this selection is made (Reid, 1978). Reid (1978) stated that the content of curriculum reflects the scope of knowledge that is considered to be important and practised in industry and society. This is the case in Singapore where the university has a tripartite relationship with the government and industries (Lee, 1983). Marsh (1991) identified the main factors affecting curriculum as firstly political, that is, education is used to promote the ideology of those in power. Secondly, the curriculum is also used to foster national identity and unity as well as to serve the economic needs of the country. These factors will in turn influence the kinds of curriculum changes to a large extent.

The word 'change', as far as curriculum is concerned, points to reform, that is changing things for the better (Kelly, 1982). The issue of what is considered 'better' is obviously subject to what each society deems to be important objectives of education and who has the dominant voice in decisions over the curriculum. In the case of
Singapore, community concerns take precedence over individual interests (Chapter Two, p. 12) and much of educational change is planned by the Ministry of Trade and Industry as well as the Ministry of Manpower (Chapter Two, p. 12).

In Singapore there is a lack of feedback from the teaching staff about desirable educational changes and their involvement in planning of these changes. Nisbet (1975) felt that there is a need for better understanding of the dynamics of change and involvement of the teaching staff. He expressed that the teaching staff should not just be told what to do but involved in planning and decision-making. In the case of this study, policy changes could either be government driven or initiated from within the university (A Message from Within NTU- Nanyang Technological University, 1997).

The ultimate aim of educational change policies in Singapore is still to serve the larger national interests and this raises the question of how this vision can be balanced with the academics' viewpoints. As Nisbet (1975) pointed out, the success of a curriculum change is dependent more on social relationships within the educational institution rather than the nature of the change itself. As early as 1985, educational research literature has shown that a negligence of teachers' beliefs in implementing change will lead to disappointing results (Richardson, 1994). The literature on educational change has therefore highlighted the importance of teaching staff's involvement in the planning and decision-making processes of change. Such literature, however, did not research the specific involvements of teaching staff at each stage of the change, given the kind of contexts they work in, both organizationally as well as the wider political, social and economic contexts of their countries. It was also unclear what will result due to a lack of teaching staff's involvement in educational change.

A lack of attention into the role of academics can result in a discrepancy between the planned change, as designed by policy-makers, and the change in practice, that is what the teaching staff finally executes. The components of change consist of
‘adoptive aims’ or the plan for teachers to adopt in an innovation (Kelly, 1982, p. 68), and ‘adaptive aims’, or the adaptation teachers make to the innovation (Kelly, 1982). In other words, ‘adaptive aims’ refer to the disparity between adoptive aims and practice (Kelly, 1982). Marsh (1991) revealed that teaching staff rationalizes the curriculum change and then decides whether to adopt it or not. Their decisions are based on a few factors: the communication of the change, their perception of its relevance, effectiveness and feasibility of the change. The claims made by Kelly (1982) and Marsh (1991) point to the need to study what really takes place when a planned curriculum change is introduced, especially with regards to how teaching staff view the change. The question is how do organizational structures within an educational system affect the communication of a curriculum change to teaching staff and thereby their responses towards it. A study on the adaptive aims of educational change in Singapore is important as firstly, no study has been done on this, and secondly, change happens rapidly with no attempt made to examine the implementation processes as well as outcomes.

This situation of economic forces driving educational change is not unique in Singapore. When we look at a global curricular change in higher education, we see a move from a traditional to convergent models of higher education. In the traditional model of higher education, the disciplines students are enrolled in determine the nature of employment they want (Weert, 2000). This changed and later and it was felt that higher education should be a preparation for occupational fields with more flexibility given to Universities to adapt their curricula to changing external needs (Weert, 2000). It was also recommended that Universities offer three types of curricular reform: broad based, practical and specialized courses (Weert, 2000). This change from a traditional to convergent model means that curriculum changes have to keep pace with external economic changes. Khoon (1991) wrote that the curriculum changes in Singapore find
their justification in preparing its limited human resource to compete in a technological and commercial world. The aims that such a new curriculum seeks to achieve are greater flexibility and diversity in their courses, as well as a closer relation to vocations (Khoon, 1991).

Educational change in Singapore is influenced by external factors, conceptualized by policy-makers and introduced from the top to lower levels. Morrison (1998) stated that a change process involves a transformation that is initiated by internal or external forces and leads to an alignment of existing values, practices and outcomes. This, however, does not explain how an alignment can take place between external and internal forces as well as between values, practices and outcomes. In other words, differences exist between the external pressures and internal operations of the educational institutions.

In addition, we cannot assume the planned curriculum change will be translated directly into practice. It does not mean that the teaching staff will implement the change as intended, or that students learn what is planned. Bolam (1975) referred to this discrepancy as the difference between the adoptive and adaptive change. Adoptive change disregards the variables in individual institution's environment and engages in a top-down linear approach. Adaptive change is more sensitive to individual school's situation and context, as well as developing capacity for change within the institution and local context. Though adaptive change seems more favorable in the educational context, adoptive change is inevitable.

It has also been said that the problem with the recent developments in education is that higher education has to meet the demands of global market (Inayatullah and Gidley, 2000; Farmham, 1999). Is there then an alignment of the educational change that is planned from above with the values of the teaching staff? What will happen to the outcome of the educational change if such alignment is not achieved? This shows
that it is important to study teaching staff's values and attitudes about a particular educational change.

There is a need to study if a match exists between the adoptive and adaptive aims of educational change in Singapore since the latter influence students' learning. Since much of the attention in the educational system in Singapore lies in training undergraduates in appropriate skills, it is important to close the gap between these two aims. The next section describes the organizational structures in the university and how they shape the nature of communication as well as academics’ involvement in curriculum change.

3.4 Effects of Organizational Structures on Academics’ Involvement in Educational Change

The literature on educational change shows that academics’ involvement is crucial to its success. The organizational structures in a university, however, can either restrict or encourage academics’ involvement in a curriculum change. Every structure has its inherent strengths and weaknesses. The question is how the different organizational models in the university affect the roles that academics play in curriculum change.

The literature points to the importance of organizational structures in the communication of educational change to academics, and providing avenues for their involvement in such a change. It must be remembered that the university is a complex organization. This is because universities face different problems as well as have a multiplicity of goals. Therefore, different structures are needed to deal with these problems. They also need to be responsive to external environment to survive and grow as organizations. The organizational complexities of the university have an effect on the lines of communication, process of decision-making as well as implementation of
curriculum changes. A bureaucratic structure is needed for an efficient administration of activities and effective accountability. In the case of Singapore, bureaucracy in the university ensures its accountability to and alignment of policies with the government. It also brings about effective dissemination of policies from the government to the different levels of the university (Chapter Two, p. 12). At the same time, a collegial model exists because the academic staff members and students would like to have a say in the decision-making of the institution. The question, therefore, is how this mix of bureaucratic and collegial structures affects the dissemination and communication of a planned curriculum change to the academics, and what avenues are available for them to participate in decisions regarding such a change.

Bureaucracy, however, results in a hierarchical nature of communication and decision-making in the university. This affects the way academics are involved in curriculum change, as well as communication between them and those at the top. In universities, decisions are formalized in committees, and procedural power becomes important (Warner and Palfreyman, 1996). There are rules by which proposals are judged, operations regulated, and the leader needs a command of the rules, control of agendas and information flow (Warner and Palfreyman, 1996). Such rules allow for efficient dissemination of information and decisions, but could also be obstacles to obtaining feedback and having collegiality in decision-making. What Warner and Palfreyman (1996) did not elaborate on are the responses of members given this top-down manner of making decisions. How do members respond to decisions, in particular, to change, and what opportunities are there for them to participate in decisions? How do they work in relation to one another given such a structure? Bureaucracy is a strong feature in Singaporean universities influenced largely by the political climate where a strong focus and power are vested on the government
Scott (1984) described the modern university as a shared bureaucratic environment that can be seen in the increased managerial roles of academic staff, forming a powerful sub-committee. This means that certain academics will have managerial authority over others, serving as heads and making curricular decisions to pass on to the rest. Bureaucracy invariably has an effect on the communication of change from the top level to the academics as well as their working relationships with higher levels and amongst themselves.

The issue of how academics are encouraged to participate in the vision of educational change for national development is complex, especially where there is a strong pressure to conform to the government’s policies of national development. Bush and West-Burham (1994) explained that there is a tension between management and education, which he calls a ‘bureaucratic-professional interface’. This is the tension between the claims of individuals to exercise personal judgment in an autonomous fashion and those of educational institutions, insisting on conformity to common values, purpose and activity (Bush and West-Burham, 1994). Noble and Pym (1970) explained that bureaucracy, with its hierarchy of formal relationships, does not allow for professionalism which involves independent exercise of individuals’ trained judgement. What Bush and West-Burham (1994) and Noble and Pym (1970) failed to explain is how teaching staff respond to educational change as a result of this pressure for them to conform. This also creates a tension for them in that they have to reconcile their professional experience and understanding of students’ learning with decisions regarding curriculum change made by policy-makers.

The literature on educational change shows that it can happen either at a superficial or deep level. Bottery and Wright (2000) asserted that for changes to occur,
they must be understood, developed and owned by those whose culture is to change. Deep change, in fact, requires involvement of the participants, in working out both the goals and processes of change (Bottery and Wright, 2000). The teacher is responsible for resolving the conflict between means and ends in education, and policies should be developed with mutual trust and respect for the participants (Richardson, 1994). The question is therefore how deep change in teaching staff can take place given the limitations of bureaucracy. This also means that a tension exists in balancing bureaucracy and collegiality in the university.

Collegiality, unlike bureaucracy, encourages maximum participation from members, feedback for improvement and utilization of professional knowledge of staff (Morgan, 1998). It allows for teamwork and a pooling of different abilities and strengths (Morgan, 1998). Farnham (1999) explained that change-oriented universities combine managerial with collegial decision-making as well as depend heavily on leadership at the middle and lower levels of management, thus reconciling the drives of central leaders with the more diverse academics. What is not clear in such an exertion is how one defines a ‘change-oriented university’, how collegial decision-making can be reconciled with academics’ voice and an agreement can reached amongst people at various levels of management. Since academics play multiple roles of administrating, managing and teaching, how do they reconcile these roles when a curriculum change is introduced? The issue is how reconciliation can be maintained among academics’ voice, the drives of the central leaders and those in authorities who initiate educational change.

The processes of decision-making and communication in an organization are shaped by its structures. Duke (2001) claimed that the modern university is faced with the tension collegiality and managerialism. Being very large organizations, Singaporean Universities are at risk of being managerial. According to Duke (2001),
when an organization is managerial, it is bureaucratic and risk averse, and the communication line is vertical. Duke’s (2001) analysis is helpful in enabling us to understand the conflicts faced by a university and see a danger that it should avoid. It does not, however, recognize the fact that the organizational structure of the university is very much influenced by the organizational structure of the country. Where there is strong state control over education, it is likely that a top-down and hierarchical structure will be found in the university. Consequently, bureaucracy is needed in the institution to disseminate and implement decisions made by the top and pass down to those below. It inevitably has an effect on the role of academics in decisions regarding educational change.

It is vital that Singapore’s universities remain open to external industries and be flexible to changes (Chapter Two, p. 12). Duke’s (2001) warning about the kinds of organizational dangers faced by universities shows how important collegiality is in preventing them from being closed and rigid. Where we see collegiality in universities, participation in the organization activities is fluid, in the sense that different individuals spend varying amount of time and effort in different decision-making (March, 1988).

There is therefore a need to study how both bureaucratic and collegial models in a university affect the functions and roles of academics in their involvement in curriculum change. Although there is literature stating how bureaucracy and collegiality both restrict and allow for academics to participate in decision-making (McCulloch, 1998), no research is identified on how academics respond to curriculum change given these structures. There is also a need to examine the specific organizational factors within these two overarching models that affect academics’ responses to curriculum change.

The bureaucratic and collegial structures in a university influence how curriculum change is communicated from policy-makers to the academics. This affects
academics' knowledge of the change, including what motivates the change; its missions, goals and purpose. The question is how effective is the communication of a curriculum change to academics, particularly in cases where such a change is planned by authorities at a higher level? The organizational structures in the university also affect the nature of collaboration amongst academics, which in turn has implications on the effectiveness of the change implementation.

McCulloch (1998) wrote that the teamwork and effectiveness of communication amongst the academics help them to implement educational change. In educational change, Hargreaves (1997) argued that it is important to balance this with an emphasis on improving internal interactions and relationships in school. He pointed out the need for teachers to collaborate, work with trust, openness and commitment to continuous improvement. Hargreaves (2000) claimed that many teachers who experience educational change go through role expansion and diffuseness, not knowing where their commitments and responsibility will end. This is the predicament that teachers in Singapore face in the midst of rapid and unpredictable educational changes. It is reported in *Towards a World Class Educational System through Enlightened School Management/Leadership and Meaningful Educational Activities: A View from the Singapore Teachers' Union*, (2000), that there is a need to monitor the effects of educational change on teaching staff's morale. Professional collaboration in this case can help them to harness their energy, and work their way through all kinds of requirements and demands (Hargreaves, 2000). He highlighted the benefits of collaboration amongst teaching staff but the issue lies in the effectiveness of their teamwork, and whether curriculum change affects the collaboration amongst them (Hargreaves, 2000). Another question is also how their teamwork helps them to cope with changes. It is therefore important to study how collaboration takes place in teams.
that academics work in as well the extent to which they are involved in the change process.

As much as present writings on educational change emphasize the need to include academics in planning, not much is known about their specific responses to curriculum change given certain organizational structures and implementation processes. There is therefore a need for research on academics' level of participation in curriculum change and the effects on their teaching. There is also a need to examine the dissemination process of curriculum change and academics' involvement in each of the stages. This process can also shape the nature of their involvement. The next section discusses, therefore, the different processes of dissemination of curriculum change.

3.5 Academics' Involvement in the Process of Change

Academics can be involved at two levels of the change process: the dissemination of change and strategies used to implement change. This section examines a model of change dissemination. This model seeks to study how academics are viewed and treated in the process of educational change.

Schon (1971) developed an early version of dissemination of change based on the centre-periphery model. This model describes how change starts with a centre, becomes diffused to secondary centres and then the periphery. It assumes that the planning of the change is located in a central body of decision-makers, and then disseminated to those on the outer layers. This model fits with the bureaucratic aspect of the university, where the central body consisting of the management, initiates and plans the changes. Curriculum dissemination is planned by a small team of 'experts' and adoption is thought to be automatic (Kelly, 1982). It is likely that this is the model used in implementation of an educational change in Singapore since the way of dealing with educational change is to form committees (Chapter Two, p. 17). The problem with
such a model is that the difficulties of passing on and implementing ideas in the educational institutions are not paid careful attention (Kelly, 1982). The model does not talk about problems that are likely to arise in the dissemination of curriculum change, in particular, with regards to academics' role in the process.

In addition, there is a need to research into academics' participation in academic change. The issue is how the assumptions underlying these models lead to the treatment of academics and the extent of decision-making power vested on them. In addition, the question lies in how their involvement in curriculum change leads to changes in their teaching practice. The next section therefore discusses the difference between planned change and change in practice.

### 3.6 Curriculum Diffusion

An important issue to remember is that in the process of disseminating curriculum change, the intended change can be modified. To address this situation, two terms have evolved: curriculum dissemination and diffusion (Kelly, 1982). The former term refers to the planned strategy for spreading change while the latter, what actually takes place in reality (Kelly, 1982). In the case of Singapore, there is a need to monitor implementation of educational changes and evaluate their effectiveness. For this reason, it is important to study the dissemination of educational change and observe what happens at the level of the teaching staff and students. The diffusion of a planned change may depend on how the teaching staff and students grasp the concept of the change and are committed to it. To examine this discrepancy, it is essential to consider the method used to disseminate the change.

It is at this level of pedagogical practice that change in terms of students' learning and training of skills can be said to take place. In Singapore, the problem with educational change is that the change objectives are not connected with existing
practice and practical realities in the educational institutions (Towards a World Class Educational System through Enlightened School Management/Leadership and Meaningful Educational Activities: A View from the Singapore Teachers’ Union, 2000).

It is argued that teachers in fact change their classroom practices all the time and adjust their teaching to the students (Richardson, 1994). Bottery and Wright (2000) asserted that for changes to occur, they must be understood, developed and owned by those whose culture is to change. The question is how this can take place in Singapore where educational changes are motivated by external circumstances rather than internal needs. Richardson (1994) and Bottery and Wright (2000) did not venture into how teaching staff’s assumptions and ownership of educational change occur. It is written that managing change involves striking a balance between people’s voice and organizational vision. Hargreaves (1997) explained that in educational change, there is often a tension between vision and voice. He stated that in the process of implementing change, it is important to encourage this voice as a way of formulating purposes and priorities in the work (Hargreaves, 1997). However, Hargreaves (1997) did not elaborate on how this tension between vision and voice arises.

There is a lack of research on classroom practices and academics’ teaching approaches when an educational change is introduced. A study by Kelly (1982) stated that there is a clear difference between the plans of curriculum development projects and their influence on the curriculum and teachers’ practice (Kelly, 1982). In fact, teaching style tended to be an extension of what existed previously rather than a total change from it (Kelly, 1982). The issue is how teaching staff can be committed to the change so that it has a substantial effect on their teaching approach. It is claimed that four aspects of individuals’ involvement in change are important: active initiation and participation; pressure and support; changes in behaviour and beliefs and overriding problem of ownership (Fullan, 1991). However, Fullan (1991) did not elaborate on how
academics can initiate, participate and gain ownership of educational change given the kinds of organizational structures they work in. Geurts and Maassen (1996) asserted that the degree to which academics influence key policy-making is a crucial governance issue since it shapes how committed they are to their institutions. The question lies in what channels of communication are available to them to give feedback on key policies. What organizational structures are available for them to participate in such decision-making? Boyatzis et al. (1991) pointed out the widely accepted view that the faculty has primary responsibility for academic curriculum and this responsibility has to be translated into effective action, collective and cooperative faculty involvement for successful innovation to occur.

3.7 An Evaluation of Empirical Studies On Educational Change

There are very few studies of academics’ responses to educational change. Only one study has been identified that is done on academics’ perspectives on educational change in Universities in two countries, the U.K. and Europe. In addition, a study was conducted on how Singaporeans in different sectors of the economy feel about innovations. Both of these studies use survey as a research method. This section discusses these studies and the methods used.

A study on academics’ responses to educational change was done in Britain, America, Japan and Europe. This was conducted by the Carnegie Foundation for the Advancement of Teaching with the administration of questionnaire surveys (Teichler, 1996). The Carnegie study showed that academics in Europe and England rated their involvement on institutional policy making as a little influential (Teichler, 1996), and their involvement in key academic policies as somewhat on the basic level (Teichler, 1996). 84% of German, U.S. and Japanese university professors indicated that they had autonomy in deciding the content of their courses while a smaller number of English
and Swedish university professors claimed this to be true of them (Teichler, 1996). The findings showed that most of academic participation was centered on primary processes such as teaching and research. They were very limited in their participation in the formation of long-term institutional policies (Boer et al., 1996). The Carnegie study showed an even spread of responses about management style, with equal number of respondents saying that the overall management style was either 'Top Down' decision or involved them in corporate planning.

The strength of the Carnegie study lies in the fact that a large number of academics in different countries were surveyed. This allows for a comparison of views gathered from academics in different positions and countries. However, only surveys were conducted in this research, which meant that there was no in-depth study of what the academics felt or thought. Neither was there opportunity for them to describe the kinds of problems they encountered with regards to their involvement in decisions or change in their Universities. The Carnegie study also did not discuss how the wider political, social and economic contexts of each country influenced the organizational structures in the Universities and the academics' involvement in decision-making. Thus, the present study examines academics' attitudes and responses to a curriculum change with greater depth.

So far, no research has been identified on teaching staff's response to educational change in Singapore. Much has been written about how national development results in the kinds of educational change such as found in Gopinathan (1996); Ashton and Sung (1997); Ashton et al. (1999) and Khoon (1991). However, there has been no research done on how teaching staff responds to these educational changes in Singapore, though a study was conducted on 127 Singaporean managers' attitudes towards innovation (Straits Knowledge-Redefining Corporate Knowledge, Feb 2002). In this study, survey forms were sent to these managers who came from
organizations such as government-linked companies, universities and schools, ministries and statutory boards, as well as companies (*Straits Knowledge–Redefining Corporate Knowledge*, 2002). Educationalists were found to be the least confident about their personal potential for innovation, though the most optimistic about innovation improvements (*Straits Knowledge–Redefining Corporate Knowledge*, 2002).

Again, only surveys were conducted in this study and no in-depth examination of members’ attitudes, beliefs and problems was done. On the other hand, the present study examines academics’ attitudes and responses to a curriculum change with greater depth. In addition, the purpose of the study on Singaporean managers was to compare Singaporeans’ attitudes across different sectors of the economy towards innovation. As such, there was no exploration of the attitudes of educationalists. There was also no comprehensive explanation offered on why they lacked confidence on their personal potential for innovation or were optimistic about it.

Although there was some attempt to find out academics’ views on their involvement in policies, decisions and change, there was a lack of in-depth examination of their perspectives, beliefs, attitudes and experiences in educational change. Surveys as a research method cannot clearly portray these underlying attitudes and problems behind academics’ involvement in curriculum change. There is therefore a need to conduct in-depth study in this area since the effectiveness of a curriculum change is dependent on academics’ involvement.

### 3.8 Proposed Conceptual Framework for Study on Educational Change

A conceptual framework was developed before the conduct of this study in order to identify the issues, focus as well as direction. According to Punch (1998), a conceptual framework helps to organize the issues, sets some kind of direction though
it provides no definite answers. Cohen et. al. (2001) described the functions of a conceptual framework as providing clarity, focusing on the key issues, setting the grounds for falsification and verification, as well as acting as a graphical representation of a particular phenomenon. Punch (1998) described qualitative data as complex, diverse and interconnected. It is necessary, therefore, to devise a way to organize the data (Punch, 1998). The conceptual framework shown in figure 3, therefore, outlines the areas that this research is examining and the possible relationships between them. At the same time, it provides a graphical representation of the focus of this research.

The framework is derived from research literature reviewed in this and the earlier chapter. It addresses issues concerning the context of educational change in Singapore, the role of academics’ involvement as well as the adoption of a planned change.

The design of the conceptual framework began with an identification of the key factors in educational change as found in the writings reviewed in this and the earlier chapter. It began at a more global level, the national context in which the curriculum change occurred, to the more focused area of the adoption of the change. The national context included what Tan et. al. (1997) described as the motivation behind educational change in Singapore and Lee’s (1983) explanation of the importance of the university as detailed in chapter two.

In terms of the influence of organizational factors on academics’ responses to educational change, a key area is communications. Hargreaves (1997) and McCulloch (1998) indicated the importance of communication in the process of educational change. A second area in the conceptual framework consisted of the extent and nature of academics’ involvement in the process of curriculum change. Geurts and Maassen (1996), Boyatzis et. al. (1991), Fullan (1991), Hargreaves (1997), Richardson (1994) and Bottery and Wright (2000) showed the importance of academics’ involvement in decisions, planning and implementation of educational, in particular, curriculum
change. The arrows in the figure 3 show the influence of these two factors on academics’ responses. Bottery and Wright (2000), as explained earlier in this chapter, described a positive response of academics as consisting of understanding and ownership of the change. The assumption is that organizational factors, such as channels of communication and participation available to the academics, have an effect on the academics’ responses to the change.

The final area that is being examined in this study is the adoption of the change. Kelly (1982), as seen earlier in this chapter, pointed to the difference between curriculum dissemination and diffusion, thus creating the awareness that the academics might not implement the change as intended. This results in a need to explore the nature of the planned change and the action taken up by the academics to implement it. Based on the assertion made by Bottery and Wright (2000), the responses of the academics to the change have an effect on their implementation of it. The overall structure of the conceptual framework is based on the theories established in a few models of change.

This framework is based on theories developed by Blenkin et. al. (1992); Etzioni and Lehman (1980); Taba (1962) and Reid (1978). Blenkin et. al. (1992) developed a few theories of individuals’ attitude to change while Etzioni and Lehman’s (1980) theory highlighted the importance of studying organizational factors in educational change. Havelock et. al. (1977), on the other hand, saw change as a process. Educational change should, likewise, be viewed as a process that should involve academics at all stages. Academics therefore play an important role in all the components of change: organizational structures; implementation process and strategies used, and the issues involved, such as whether there is a match between planned change and change in practice.

Individuals’ attitudes to change are influenced by contextual factors like perspective of change in which they live, as well as the political, social and economic
factors in their countries. Blenkin et. al. (1992) held change to be an inevitable phenomenon in the face of an ever-changing environment. Based on this view, education must allow for change, respond and plan accordingly (Blenkin et. al., 1992). It asks the question: what kind of approach to education, knowledge and learning, is appropriate for a changing society (Blenkin et. al., 1992). The role of education is to prepare students to face this world of constant change by training them to cope with changes. This means that training of skills, particularly skills related to facing new situations, will be more important than mere accumulation of knowledge. In other words, the curriculum should focus on teaching approaches that foster such critical thinking skills. Logically speaking, this will also be the same general attitude towards educational change.

The social attitude to change influences the organization’s response and implementation to change and thereby the individual’s response. The relationship between these three features is interdependent in nature, meaning that each influences the other. Etzioni and Lehman (1980) believed that organizational factors account for individuals’ behaviour towards change. Taba (1962) wrote that it is impossible to change curriculum without changing people and institution. Reid (1978) wrote that the curriculum is the result of a balance between three features of the educational institution as an organization: the technology, social system and theory. Technology refers to how the organization achieves its tasks; social system, the form of relationships involving teachers and students, and theory, understanding of how students learn and how teachers should act (Reid, 1978). How possible is it, then, to study the organizational features without examining the human factors?

The areas of focus in this study are therefore derived from the literature on the important considerations with regards to educational change. The models established by Blenkin et. al. (1992); Etzioni and Lehman (1980); Taba (1962) and Reid (1978)
Figure 3 - Factors Affecting Academics' Responses to Change

External and Organizational Factors
Etzioni and Lehman (1980); Taba (1962) and Reid (1978).

Context of Change - Nationwide: political, economic and social.

Organizational Structures and Effects On Academics' Knowledge of the Change: Motivation, and expected outcomes, purpose,

Involvement in the process of change: Top Down or Bottom Up Change, Strategies for Implementation of the change.

Viewpoints of Change

Academics' Responses To Change (Blenkin et. al. 1992)

Curriculum Diffusion

Academics' Consequent Adoption of the Change?
Adjustments to their:
1. teaching
2. course syllabus
3. organization of work like structuring of teams

provide an overall structure, bringing these factors together and providing some guidelines as to how they can be related. This study examines the state of each of these areas and the nature of influence that each has on the other. In this sense, this conceptual framework sets the direction for this study. Figure 3 below illustrates therefore the framework for the present study. Each of the areas in the framework is explained in greater detail in the writing following the diagram.
Figure 3 shows that three factors influence academics' responses to educational change: external factors such as politics, economics and social situation; the organizational structure of the educational institution; and the degree of involvement of academics in the change process. Blenkins' et. al. (1992) theory held that external factors influence an individual's attitude to change. The organizational structure, on the other hand, has an effect on opportunities available to academics in participating as well as giving feedback to educational change. Their involvement in this process of change in turn influences their commitment to the change. These three factors therefore shape the academics' responses to the educational change, and ultimately, their adoption of the change in terms of their teaching approaches and practice. In a sense, all the three factors are related. The political system in a country influences the organizational structure of an educational system, which in turn influences the opportunities open for teaching staff to participate in educational change. This study has chosen to examine these three factors because it is concerned to show that external and organizational factors can influence and change academics' responses to educational change.

This conceptual framework, shown in figure 3, is developed out of the belief that educational change must be studied in a holistic manner: in the context it occurs in; the organizational structures of the educational institutions and the social relationships that exist within. It is important to strike a balance in these three areas, external economic needs should not take precedence over the internal state of the educational institutions or the opinions of individuals subsume the interests of the State. In addition, this framework allows for an examination of the relationship between the organizational and personal factors in educational change which is a gap in present researches. It addresses the issue of how organizational factors can either provide opportunities for or inhibit individuals' involvement in the change process. This
framework also provides opportunities for the exploration of academics’ involvement and interaction in the implementation of the change that have not been studied thus far. This is possible because this conceptual framework focuses on both the influence of organizational factors on the academics and their interaction. The concern is with a qualitative study of the primary responses of academics and students involved in the curricular change that have not been revealed so far.

The outcome of the educational change lies in students’ learning. At the end of the implementation process is the academics’ adoption of the change. The question is whether they adopt the change, and the kinds of changes they make to their teaching. In figure 3, ‘academic responses’ refer to their perspectives, attitudes and feelings about the educational change, whereas, ‘adoption’ refers to their consequent actions. It is assumed that for their actions or teaching approach to be changed, their attitudes and mindset should be influenced by the educational change introduced.

For this reason, the theories of Taba (1962) and Reid (1978) are used in this study as they view a combination of methods, people and social relationships to be the vehicle of change. This highlights the importance of a consideration of people’s views, beliefs, attitudes as well as relationships. Blenkin’s et. al. (1990) perspective of change reflects the belief about change in Singapore. In Singapore where there are no natural resources, there is an urgency to observe and adapt to global economic changes. Change is therefore viewed to be inevitable and necessary for survival. Havelock’s et. al. (1977) theory was chosen because it emphasizes change as a process. In other words, the implementation of an educational change should not be assumed to be successful just because the change is well conceived. Havelock’s et. al. (1977) theory states that as a process, the change needs constant review and improvement and the question is whether this is done in Singapore. Havelock et. al. (1977), Taba (1962) and
Reid (1978) developed criteria that have not been emphasized enough in the planning and dissemination of educational change in Singapore nor researched upon.

A gap exists in research thus far in that no study has been done on academics’ responses to curriculum change. The literature reviewed in this chapter pointed to the importance of academics’ involvement in educational change and the undesirable consequences when they are not involved. The literature on curriculum change also noted that a combination of factors shape academics’ responses to educational change: national factors like politics and economics, organizational structures of the University, and the process of implementation of the innovation.

These factors in themselves are not static but are constantly changing. All these indicated that in curriculum change it is important to study three features: the organizational, the individual and the wider political, social and economic factors. Much has already been written on the political, social and economic factors affecting educational change in Singapore as seen in the previous chapter but there has been no study done on teaching staff’s responses.

The literature on educational change discussed how academics’ attitudes and thinking about teaching could be influenced by their involvement in the change process. This chapter has provided a framework for the present study by firstly, reporting on the organizational structures which either restrict or encourage participation and communication about educational change. Secondly, it shows how change in itself is a process, and how academics’ adoption of the change results from a process of changing their attitudes. This chapter has therefore illustrated how the underlying purpose of the present study arises from the writings, studies and gap in educational change research. The concern with individuals’ viewpoints guides the research paradigm and methodology adopted in this study. The following chapter therefore proceeds to show how the objectives of this study are drawn from this
literature. It also presents the research questions, research paradigm and methodology used in this study.
CHAPTER FOUR
METHODOLOGY

4.1 Introduction

The previous chapter describes how academics’ responses to and involvement in curriculum change are crucial in educational change. This gives rise to the conceptual framework as well as the formulation of the research aim and questions in this research. This chapter describes how the research paradigm is developed to reach this aim. This paradigm involves a qualitative approach. The literature shows that it is important to involve academics as well as study social relationships in making educational change. The research paradigm and design chosen in this study paved the way to examine academics’ viewpoints. This was accomplished through the use of research tools like semi-structured interviews, focus group discussion and documentary analysis. The research paradigm therefore focused on the perceptions of academic staff and students.

This chapter begins with an outline of the research objectives and continues with a description of the research design in this study. It shows how these objectives lead to the research method and tools used. The research approach used in this study is embedded case study and the reasons for this choice are outlined below. The strengths and weaknesses of research tools used are also discussed, followed by a justification of their use in this study. In addition, a discussion of the pilot study conducted and how it contributes to the main study are included. Ethical issues surrounding this study are discussed in the last section of this chapter.
4.2 Research Objectives

This study aims to examine how organizational factors affect academics’ responses to a curriculum change. Part of this involves finding out how the curriculum change is communicated from a national to university level, the effects on academics’ responses and their adoption of it. This study seeks answers to the following research questions:

1. How do organizational factors influence academics’ responses to curriculum change?
2. How do academics respond to the curriculum change?
3. How do the academics work together to implement the planned curriculum change?
4. What changes they make to course structure and teaching?
5. How is students’ learning changed?

(Chapter One, p. 5)

Since this study seeks to examine the views of individuals, a qualitative approach is chosen as this allows for an in-depth examination. For the same reason, the research approach chosen is case study and the methods used included interviews with the academic staff, focus interviews with the students and documentary analysis. The strengths and weaknesses of each of these methods are discussed in this chapter. In addition, a profile of the academics and students involved in this study is given. The qualitative research method used involved a triangulation of three methods. Semi-structured interviews were carried out with 10% of the total population of teaching staff members and focus group interviews with 5% of the student population affected by the curriculum change. In addition, documentary analysis was done on curriculum, planning and policy documents as well as annual reports. Analysis and triangulation of the data were then carried out.
4.3 Research Paradigm – Qualitative Approach to Research

This research is located within the qualitative research paradigm. A qualitative research approach is adopted in this study because this research acknowledges the significance of the human element in studying educational change that is not possible to achieve through quantitative studies. In the case of this study, such an approach allows for an investigation of academics’ involvement in, and responses to, curriculum change. In addition, qualitative research seeks definitions in context or as the study progresses whereas quantitative approach sets precise definitions at the beginning (Fraenkel, 2000). This study is interested in examining the context in which the curriculum change occurs and seeks to avoid presuppositions about this situation.

In qualitative research, narratives are the preference, while in quantitative research data are reduced to numbers (Fraenkel, 2000). This study also prefers to analyze data inductively by putting together the picture as they are being collected. In terms of analysis, quantitative research breaks down complex phenomena into specific parts for analysis while qualitative research seeks holistic description of complex phenomena (Fraenkel, 2000). Since curriculum change is a complex phenomenon involving social relationships, this study seeks to examine it in a holistic way. In addition, validity is tested through a series of statistical procedures in quantitative research while in qualitative research, it is done through triangulation (Fraenkel, 2000). This research prefers to establish validity through a triangulation of accounts from various sources. Lastly, a qualitative approach is concerned with the process which suits the purpose of this study as it seeks to examine the process of educational change.
Qualitative approach, in the case of the present research, allows the researcher to examine curriculum change with openness, honesty and entirety. It also allows for an examination of the subjective experiences of the academics. These experiences can be described in narratives that are comprehensible to the readers. In addition, the case study approach is chosen as it allows for an in-depth examination of individuals' perspectives. The next section therefore goes on to discuss the merits and weaknesses of this approach.

4.4 Case Study

This research examines an embedded case study of a curriculum change in the School of Electrical and Electronics Engineering in a university in Singapore. This is a university with the largest number of Engineering Schools as well as enrolment of students in engineering courses. The University has an annual intake averaging 1,400 engineering students and over 600 engineering academic staff. Upon entering the University, these students have to undertake a year of common engineering which was changed to two years at the time this study was conducted. This is the curriculum change that this research studies. The School of Electrical and Electronic Engineering has an intake of 890 students and two hundred and 53 academics with different specializations in electrical and electronics engineering. This School of Electrical and Electronic Engineering was chosen for the case study because it is the School that the present researcher is teaching in and therefore the subjects and data are more accessible to her. In addition, it is the biggest Engineering School in the University so that the sample selected can be more representative since the School has 63% of the total population of engineering students and about 40% of the academic staff. It must be noted as well that not all students enrolled into the engineering program in this University has selected engineering as their choice. Many
might not have been granted the course of their wish because there were quotas placed on courses in the public universities in Singapore and their grades did not meet the cut-off points. This leads to a situation where the academics find themselves teaching a large population of students with diverse abilities and motivation in learning.

As a qualitative research approach, case study is advantageous in that it allows the researcher to study the issues in depth. In addition, it tries to understand the situation of people in their natural setting, offers the researcher understanding of the larger social complexity of people, their actions and motives (Feagin et al, 1991). It also allows the researcher to examine the effects of a complex network of social interaction (Feagin et al, 1991), as well as examine people's views in a research issue. This makes the case study a suitable approach for this study, where the interest lies in finding out how academics work together to implement a curriculum change. It allows such social interaction to be studied in its specific context. Due to the fact that case study describes people's experiences and social interaction, it is more comprehensible to a wider readership than statistics. This makes it more useful in studies on educational change since the aim is to reach more people and enable them to relate to situations and people involved in curriculum change.

The advantage of the case study approach is that it can be understood by a wider readership beyond the professional research circle, and that they are immediately understood as well as having a three-dimensional reality (Nisbet, 1975). This is because the context of the data is made explicit in the presentation of the research and the data are also described in an everyday language readers can understand. The narrative style presents information in a way that people can relate to, and they could compare and reflect on their experiences to those recorded. Rather than present findings to readers as
unquestionable and objective facts, such a narrative account could leave readers to decide on relevance information to themselves in the light of context and interpretations.

In research on educational change, an understanding of specific contexts would be both enlightening and important to both researchers and practitioners since it is understood that no two teaching situations are exactly alike. It is therefore up to the readers of the study to apply knowledge gathered to their own situations. Data collected from case studies form an archive of descriptive materials for future reinterpretation, and in the varied and complex context of education, this is a valuable data source for researchers, evaluators and policy-makers (Bell et al., 1984). The key point here is the varied and complex context since it cannot be assumed that a curriculum change that works in one situation can be directly applied to another. Likewise, decisions about curriculum change must be made bearing in mind the uniqueness of each educational situation. The strengths of the case study approach therefore suit the purposes of this research.

In this study, this problem of convergent validity is overcome by a triangulation of data gathered using different methods, validity could be established by cross checking of these findings (Feagin et al., 1991). What the documents, academics and students said about these issues were compared for triangulation of data. The present researcher identified the key themes in the interviews and compared divergences from these. This process allowed the researcher to focus on the research aim while not ignoring divergences from the central themes. This was however not a neat process as she had to decide how the responses fitted into the themes and were related. In the last stage of data analysis, the researcher reviewed the data and compared these with the themes in the conceptual framework shown in figure 3 (Chapter Three, p. 46). The researcher also developed more
general and abstract truths about the implementation of curriculum change in Singapore and a theory which is presented at the end of chapter seven.

The present study examines the views of academics from only one school in a university which classifies it as an embedded case study approach. Such an approach refers to an examination of a sub-unit within a single organization (Yin, 2003). Yin (2003) warned that the pitfall of embedded case study lies in the fact that it focuses on a sub-unit and fails to return to the whole organization. He argued that in this instance, the sub-unit becomes the context rather than the target of study. While this is a situation that the present researcher should be wary of, it can be avoided if the number of subjects is a good representation of the population. This happens when the sample is large enough or where the subjects represent different sectors of the organization. In the present study, the academics interviewed came from the largest School in the University. In addition, 78% of the academics interviewed were involved in planning the curriculum across all the Engineering Schools. They had therefore been involved in discussing the changes to the curriculum and potential problems with academics of other Schools. It is possible, however, that the other engineering Schools have specific problems related to their disciplines but this is an area beyond the scope of this study. In addition, the students chosen for the interviews belonged to the common engineering program, and not to any specific Engineering Schools. This makes the subjects a more representative sample of the common engineering program. An embedded case study approach is chosen because the concern is with an in-depth examination of academics' responses.

In this study, interviews and documentary analysis were used as the research tools within this case study approach. Interview tool was chosen because it allowed the researcher to uncover issues and problems related to curriculum change as well as explore
a wide range of these issues. As a research tool, however, it is rather obtrusive, as interviewees may be afraid of how the information revealed will be used. Documentary analysis was therefore used to complement interviews because it is an unobtrusive research tool. There are, however, other problems related to its use. The sections that follow therefore discuss the strengths, weaknesses of, and justification for using interviews and documentary analysis, as well as report on the conduct of these tools.

4.5 Interviews

The semi-structured interview was selected as a research tool in this study as it allowed the researcher to find out the views of the interviewees as well as probe in depth into issues that arise from their responses. It enabled the researcher to investigate the actual issues rather than predetermine them for the subjects. This section discusses the strengths and weaknesses of this research method and how this study sought to lessen the weaknesses. It also describes the questionnaire instrument used and conduct of the interviews.

4.5.1 Justification of Using Interviews as a Research Tool

The strengths of the interviewing method are that rich insights could be gained about people’s perspectives, attitude, feelings, experiences and opinions about a certain topic (May, 1997). The use of interviews requires a certain approach and attitude towards research that holds people’s views and experiences to be important and respected. This suits the purposes of this research as it takes the position of respecting the views of the academics. Interview accepts differences in groups of people rather than attempt to measure reality (Rubin, 1995). The concern of this study is to relate, as explicitly as
possible, the academics' experiences in a narrative. Silverman (1997) argued that it is through this non-positivistic element, that a subjective depth and mutual understanding can be achieved. It is such social relationships that this study seeks to examine. This study also aims at achieving a deeper understanding of people's responses to educational change. This is the strength in interviews that is particularly useful in the present study, though there are also weaknesses in this research method that have to be dealt with.

In using interviews as a research method, it is also important to be aware of the danger of interpreting what we hear according to our own bias and framing. This entails knowledge of firstly, such risks, and appropriate interviewing skills. According to Rubin (1995) interviewing involves a relationship between interviewers and interviewees that imposes obligation on both parties. In other words, how tightly or loosely the interviewer controls the interview can affect the responses from the interviewees, and interviewees' perception of the interviewing situations in terms of what the interviewers expect can also affect his responses (Silverman, 1997). In this study, therefore, the research aims and questions are also made explicit to the interviewees and they are given time to consider whether to participate in it or not. Sample bias can exist, that is choosing sample that is not representative of the population studied. The researcher attempts to prevent or overcome these problems by selecting respondents across all the disciplines in the School, asking open questions, seeking clarifications and reassuring them that they will remain anonymous. In addition, there is the problem of the straitjacket interview where the questions permit little latitude, namely they are closed-ended questions, and lastly, respondent bias in which the respondents give answers related to more public relations rather than an accurate response (Wragg, 1994). To overcome this, open-ended questions were used which allowed the interviewees to express their views about the curriculum
change. The following sub-section describes the selection of sample; the questionnaire instrument and conduct of the interviews in greater detail.

4.5.2 Sampling

There are 253 academic staff members in the School of Electrical and Electronic Engineering. Semi-structured interviews were conducted with 23 academic staff members. The interviewees came from all the 6 divisions in the School as well as a smaller sub-division known as ICIS or Information, Communication Institute of Singapore (Chapter Four, Table 4, p. 63). This was to get a range of views from academics who were teaching different subject areas. These interviews were also conducted one year after the curriculum change was made. Therefore, the academics had a year experience with the new curriculum and also time to reflect on how it had worked so far.

A mix of purposive and convenience sampling methods was chosen. Purposive sampling refers to the selection of subjects because of some characteristics while convenience sampling points to selection of subjects who are available (Breakwell, 1990). Purposive sampling was used because the researcher was interested in getting views from academics at the different levels in the School’s management as it was expected that they would be involved in different extent in implementing the curriculum change according to their positions. With the purposive sample, the Vice-deans were approached as it was felt that they were able to give a higher-level view to issues as well as processes involved in the change. The interviews, however, did not include members of the senior management and, therefore, the researcher had no access to their long-term planning strategy. To avoid bias in the data, a convenience sample was chosen, and it was fortunate that, in the process, academics included in the sample were from different positions; divisions, and possessed
varying duration of teaching experience in the School. In addition, the researcher had to use convenience sampling because the population of academic staff in the School was too big and she did not know most of them. She therefore approached a few of the academics she knew as well as those whom she met in the School’s training workshops. It happened that the ones she approached came from different divisions and were involved in different capacities as program directors, course coordinators, lecturers and tutors of courses. This was very fortunate considering her aim was to get views from academics involved in different extent in implementing the curriculum change. It was hoped that such diversity would produce varied perspectives on the change to broaden the engineering curriculum, as well as different opinions about the effects of the change. The distribution of the academics in terms of their positions, the subjects they were teaching and the divisions they belonged to are shown in the Tables 1 and 2 below.

Table 1 shows the distribution of academics interviewed according to their positions in the organizational hierarchy of the School. The Vice-deans fall into the second tier in the management hierarchy the School, under the School’s Dean (Chapter Two, Figure 1, p. 20). Each of them has a portfolio. For example, the Vice-dean of Research oversees research in the School; the Vice-dean of Students’ Affairs takes care of matters relating to students, and Vice-dean of Academic handles the curriculum and academic responsibilities. Below the Vice-deans are the Heads of Division who manages the divisions with the assistance of coordinators. The coordinators work together with a team of academics teaching the same courses offered within the divisions. Academics teaching non-engineering subjects come under the division in the Dean’s office. Such courses include ‘Communication Skills’, ‘Engineering and Society’, ‘Economics’, ‘Principles of Law’ and ‘Management’.
Table 2 shows the distribution of academics according to the levels of courses they are teaching and Table 3, the levels they are coordinating. Academics teaching all levels of the Bachelor of Engineering program were chosen as curriculum change in the School was always planned at all levels. In other words, when a curriculum change is introduced the academics teaching the levels affected will decide what to include or exclude from their present courses. Subsequently, those teaching the higher levels have to make the relevant adjustments to their courses so that students are able to follow through what they learned in the first year. The curriculum change is therefore planned simultaneously by the academics teaching all levels in the Bachelor of Engineering program. Though the broadening of the curriculum occurs in the first and second years, those teaching third and fourth years are involved in discussions of the change at the same time as those teaching the first and second years. The academics teaching third and fourth year could be affected in three ways. Firstly, they have to make adjustments to their present courses, depending on how the syllabus of the first and second years had been changed. Secondly, they have to design new courses, if new courses were introduced in the first two years. Finally, the courses they were presently teaching might be dropped altogether. In which case, they would be given new courses to teaching. For this reason, it was felt that the academics teaching all the four levels of the Bachelor of Engineering were involved in planning of the curriculum change as well as being affected by it.
Table 1 - Distribution of Academics by Position in the School’s Hierarchy

<table>
<thead>
<tr>
<th>Position of Academic Staff</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academics Involved in Teaching Only (either Lectures or Tutorials)</td>
<td>7</td>
</tr>
<tr>
<td>Co-ordinators of Subjects</td>
<td>10</td>
</tr>
<tr>
<td>Member of Curriculum Committee</td>
<td>1</td>
</tr>
<tr>
<td>Head of Division</td>
<td>1</td>
</tr>
<tr>
<td>Program Director (at Masters Level)</td>
<td>1</td>
</tr>
<tr>
<td>Vice-deans</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
</tr>
</tbody>
</table>

Table 2 - Distribution of Interviewees by Level Taught

<table>
<thead>
<tr>
<th>Levels</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st, 3rd Years and Postgraduate</td>
<td>1</td>
</tr>
<tr>
<td>1st, 4th Years and Postgraduate</td>
<td>1</td>
</tr>
<tr>
<td>2nd Year Only</td>
<td>8</td>
</tr>
<tr>
<td>2nd and 4th Years</td>
<td>3</td>
</tr>
<tr>
<td>2nd, 3rd and 4th Years</td>
<td>2</td>
</tr>
<tr>
<td>2nd and 3rd Years</td>
<td>1</td>
</tr>
<tr>
<td>4th Year Only</td>
<td>3</td>
</tr>
<tr>
<td>4th Year and Postgraduate</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
</tr>
</tbody>
</table>

Table 3 - Distribution of Interviewees by Levels Coordinated

<table>
<thead>
<tr>
<th>Levels</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Year Subjects</td>
<td>1</td>
</tr>
<tr>
<td>2nd Year Subjects</td>
<td>3</td>
</tr>
<tr>
<td>2nd Year and Masters Level Subjects</td>
<td>1</td>
</tr>
<tr>
<td>3rd Year Laboratory and 4th Year Subjects</td>
<td>1</td>
</tr>
<tr>
<td>4th Year Subjects</td>
<td>2</td>
</tr>
<tr>
<td>Masters Level Subjects</td>
<td>1</td>
</tr>
<tr>
<td>General Electives Subjects</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
</tr>
</tbody>
</table>
Table 4 – Distribution of Interviewees by Division

<table>
<thead>
<tr>
<th>Divisions</th>
<th>Number of Academics Interviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Power Engineering</td>
<td>1</td>
</tr>
<tr>
<td>2. Circuits and System</td>
<td>2</td>
</tr>
<tr>
<td>3. Information Engineering</td>
<td>2</td>
</tr>
<tr>
<td>4. Control and Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>5. Communication Engineering</td>
<td>3</td>
</tr>
<tr>
<td>6. Microelectronics</td>
<td>5</td>
</tr>
<tr>
<td>7. Information Communication Institute of Singapore</td>
<td>1</td>
</tr>
<tr>
<td>8. Dean’s Office:</td>
<td></td>
</tr>
<tr>
<td>Communication Skills</td>
<td>3</td>
</tr>
<tr>
<td>Economics</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
</tr>
</tbody>
</table>

4.5.3 Conduct of the Interviews

The interview schedule (Appendix 1, p. 217) covers a few main areas: motivation for the curriculum change; institution support; collegiality and collaboration amongst the academic staff, and changes made to the curriculum as well as their teaching practices. With regards to motivation of the change, they were asked if they were aware of the factors motivating the change, what the industries thought of it and whether they were clear about the direction of the change. In terms of institutional support, they were asked what channels of communication were used to give them information and gather their feedback; their knowledge of the source; goals of the change and involvement in the implementation process. In the area of collegiality and collaboration, they were asked how well their team worked together, and whether there was clear communication in their team. In terms of the changes to the curriculum put in practice, they were queried on what they thought of students’ responses to the curriculum change and whether the educational change would
benefit students’ learning. Lastly, they were asked what kinds of changes they made to their teaching as a result of this curriculum change.

Each interview lasted about thirty minutes. The researcher posed a question and allowed the academics time to respond to it. She encouraged them to elaborate on key points they raised by asking further questions or repeating words they used. They were very spontaneous in their responses as they had just gone through the initial teething problems of implementing the new curriculum. The interviews were tape-recorded so that the researcher could note the exact words, analogies and metaphors they used which had bearing on their feelings about the issue. The disadvantage of taping the interviews was that it made the interviewees very conscious of what they said. They were also afraid of how the information would be used or disseminated later. Since this was an issue concerning their work, they were apprehensive of the repercussions. The researcher overcame their fears by reassuring them that she would show them the transcripts of the interviews to ensure she did not misrepresent them. Also, she told them they would remain anonymous in her report so that what they said would not be used against them. In addition, as the interviews progressed, the academics became more involved in discussing the issues and forgot about the tape-recording, thus overcoming their self-consciousness.

4.6 Pilot Study

Yin (2003) wrote that a pilot case study may be chosen for the reason that the informants are accessible. The pilot case study helps to refine the data collection with regards to content and procedures (Yin, 2003). It is ‘formative’ in the sense that it develops lines of question that clarifies the research design (Yin, 2003, Chapter Four, p. 79). In the present study, some prominent issues related to the research questions were discovered.
through the pilot study, and this led to the development of certain questions of inquiry. One of these key issues consisted of whether adequate time was given to the implementation of curriculum change. In addition, other issues related to the academics were examined: the effectiveness of teamwork; the clarity of the aim and purpose of the change, and the degree of involvement.

In the present study, the interview schedule was piloted before the conduct of the main study. The purpose of conducting a pilot study was to find out if the interview schedule yielded data required to achieve the research objectives set in this study. In this pilot study, a qualitative research method was used, involving semi-structured interviews with five academic staff members. The questionnaire schedule covered the same areas as the one used in the main study. Out of the five academics selected in this pilot study, two of them taught Communication Skills; one Economics and two, engineering courses. The academics selected taught both engineering and non-engineering courses. Out of these five, three were course coordinators while the other two were course lecturers and tutors. Each interview lasted half an hour and more questions were asked to clarify points or further probe where needed. It was discovered through this pilot study that the interview questions elicited data that addressed the research questions. Yin (2003) claimed that methodologically, the pilot study provides information on relevant questions in a field study. The findings from this pilot study were particularly useful in test-running the research questions to see if they met the research aims. Yin (2003) wrote likewise that the data from the pilot give substantial insight into the main issues being studied. Consequently, the same questionnaire and interview format were used in the main study.
4.7 Focus Group Discussion

Focus group discussions were carried out with the students enrolled in the School of the present study. The data from these discussions were compared with those collected from interviews with the academics to find out how the academics implemented the curriculum change in their teaching approaches, and whether the students' learning had changed. The following section discusses what a focus groups research is and its benefits and problems as a research method. The section that follows describes the conduct of the focus group discussion.

4.7.1 Justification of Use of Focus Groups as a Research Method

Focus group discussion is another kind of interview research method. Barbour (1999) defined them as group discussions that explore a certain set of issues. It is focused in the sense that it centres on a collective activity, like talking about certain questions and data are generated from this discussion (Barbour, 1999). Morgan (1997) explained that, here, the focus is provided by the researcher. Vaughn (1996) claimed that it is a useful research method if the researcher is interested to hear what participants think.

One of the strengths of focus group research is that it will generate a vast amount of data on views of a particular topic. In addition, it is able to produce quantity and breadth of feedback on an issue (Krueger, 1994). It is also able to produce a large amount of data on a topic of interest (Morgan, 1997). Furthermore, it allows the researcher to observe the group's interaction on the research topic. The advantage that focus groups research has over interviews is that it provides the opportunity to observe interaction (Morgan, 1997). In addition, it allows the researcher some amount of control in the discussion since s/he is the one to set the focus and agenda.
In the case of this study, focus helps to ease the different power relations between the researcher who is an academic and her students. In a normal interview situation, when one student faces the researcher who is also his/her teacher, the student may be too afraid to reveal some of his/her true feelings about the curriculum change. When students are involved in focus group discussions, the presence of a group of their contemporaries help to ease this tension. Also, they do not feel they are alone voicing their individual perspectives but they can be encouraged when others support their views. They can find strength in consensus and where there are differences of views, it allows the researcher to see how they respond to contrary opinions. In other words, the dynamism of the discussion not only allows the researcher to gather a rich source of data, but also observe the group interaction. Barbour (1999) argued that focus groups as a research method is more useful for studying change compared to methods that rely on administering questionnaires. By doing this, a broader picture of change can be obtained, giving an insight to group and not just individual perspectives (Barbour, 1999). Also, the comparisons the participants make of each other’s experiences and opinions help us to understand the complex behaviour and motivations that lie behind (Morgan, 1997). It is precisely this social-interaction aspect of focus group that helps the present researcher to achieve her research aim, as well as to fill in the research gap on curriculum change, where only quantitative methods were used thus far.

It is argued that the predominant method used to investigate change in an organization has been positivistic (Barbour, 1999). This results in shortcomings like not being able to study the change process in a temporal or contextual manner (Barbour, 1999). Such a consensus view of organization and the positivistic methods used to study it assumes that changes have clear beginnings and endings, resulting in studies on isolated
events in change (Barbour, 1999). In other words, rather than study change realistically in its context, positivistic methods have misrepresented the change process by giving the idea that it is a linear and individual event.

What this study sought to show was that a complex relationship exists between the change process; agents (or those who implement the change); recipients and organization. Its aim was to portray this interaction of different factors in managing change and describe the context. Focus groups discussions therefore allowed the researcher to gain insights into these group dynamics and processes that were crucial to the study of changes. They help to fill the gap in educational change research. In addition, the rich amount of data collected through focus group research made it possible to compare these with data collected through other methods. In the case of this study where three different research methods were used, this was particularly useful, especially where the goal was to carry out a triangulation of the different sources of data.

There are obvious advantages in gathering data through group interaction as in the case of focus group research. The large amount of data generated allows them to be used with other research methods. Individual interviews and focus groups, as an example, can be used together in a study and in fact complement each other. They have their specific strengths and weaknesses, the strengths of one covering up for the weaknesses of the other. Michell (1999) discovered the importance of combining focus groups with individual interviews and the fact that all data are context-bound. In comparing the benefits of interviews and focus groups in a particular study, the researcher must also consider the cultural and institutional features that may either encourage or suppress the expression of certain views (Michell, 1999). The opportunity given to the researcher to observe group interactions also makes focus groups useful method in studying organizational change,
where people’s views, participation and decisions play an important and integral part in both the processes and outcomes of the change. It is also a flexible method that allows the research process to be more accessible to the participants and its analytic nature helps us understand the processes involved in organizational change (Barbour, 1999; Kitzinger and Farquher, 1999).

The strengths of focus group research therefore help the present researcher achieve her aim of gathering views on the topic of curriculum change, and overcome the power-relations-differential between herself and her subjects, namely her students. For the purposes of analysis, the data collected are also suitable for comparison with those gathered from individual interviews. This makes focus group research a suitable method for the objectives, conduct and analysis of this study. The following section describes the conduct of focus group discussion amongst students in this study.

4.7.2 Conduct of Focus Group Interviews

Focus group discussions were carried out with year 1 and 2 students of the Bachelor of Engineering program in the School being studied. These were the students enrolled in the two-year common engineering program. There were a total of 2800 students in these two years, 1400 in each level. A total of 63 year 1 students from three tutorial groups, and 40 year 2 students from two tutorial groups, were interviewed. This formed about 5% of the student population. Convenience sampling was used as the researcher was teaching five classes of these first-year common engineering students.

The students who participated in the study were the three classes of Year 1 students and two classes of Year 2 the researcher taught. The Year 2 students were the first batch of students to undergo the two-year common engineering program. They were able to
compare notes with the third year students, and formulate their opinions on the change. The year 1 students were experiencing their second semester of the two-year common engineering program. They had to make a choice about their specializations in engineering at the end of year one.

The researcher informed her students of the aims, research questions and dissemination of research results and asked if they would like to participate in her research. She gave them one week to consider and met the students in groups of four to five students in her office to conduct the focus group discussions. When they met in her office, she explained the purpose of the research again and proceeded to ask the questions. She encouraged the students to respond freely and comment on the issues. Each interview lasted about 30 minutes and was tape-recorded. Initially the students were rather hesitant in their responses but as they became involved in the discussions, they became more animated. Since this was an issue close to their hearts, they were very keen to express opinions of their experiences and difficulties in the curriculum. The researcher then transcribed the interviews, noting down what each student said.

4.8 Analysis of Interview Data

It is argued that the standards for qualitative research are 'transparency, consistency-coherence, and communicability' (Rubin, 1995, p. 85), or what Punch (1998) described as systematic, disciplined and transparent. Transparency means that the reader should be aware of the processes of data collection, as well as have access to records of the interview transcripts. Concerning being systematic, Punch (1998) explained that the three stages of qualitative data analysis are data reduction, data display and drawing as well as verifying conclusions.
In the first stage of data analysis, data reduction is carried out. This involves summarizing the data, coding, memoing and finding themes, clusters as well as patterns (Punch, 1998). The interviews conducted with the academics and students were recorded using a tape recorder and transcribed. Each interview was then summarized and sent back to the interviewees for verification. Any errors made in interpretation were then amended. The analysis of the interview data consisted of coding; identifying themes; categorizing; looking at variables; counting frequency, and examining use of metaphors.

In this study, the procedure of data analysis consisted first of development of codes according to the themes of the research questions. Secondly, these themes were categorized into the main areas of the research represented in the conceptual framework developed in this study (Chapter Three, Figure 3, p. 46). These themes are: the academics' knowledge of the motivation, purpose and goals of the change, the way the change is communicated to them, their involvement in and responses to the implementation process, the curriculum diffusion and the academics' adoption of the change. The interview transcripts of the academics and students were analyzed separately first and then compared at the final stage.

In the second stage which is data display, the information is organized by using visual representations such as charts or diagrams (Punch, 1998). In this study, this was done with the use of diagrams. Each main theme was circled and branches were drawn from each theme. Each of the responses of interviewees was noted at the end of the branches. Variations in these areas were also recorded by drawing branches from these, creating a kind of web with branches radiating from the theme. In addition, the metaphors used by the academics and students were examined. The researcher then studied the variety of responses related to each theme as well as how the responses were related to
each other. Comparisons and contrasts of the responses were examined. This pushed the analysis forward to the final stage of drawing conclusions as identified by Punch (1998).

Punch (1998) explained that vague propositions may be drawn at early part of the analysis and sharpened further on. In this study, this took place by drawing propositions from the responses related to each theme in the conceptual framework shown in figure 3 (Chapter Three, p. 46), and the relationships between them. These propositions were reviewed a few times before conclusions were reached. The procedure of reaching conclusions involved observing the frequency of the responses related to each theme. The number of contradictions to the most frequently occurring views was also examined. Following this, deductions were made regarding the nature of relationships between the variations in responses concerning each theme. The researcher asked the questions: ‘What are the dominant views relating to each theme?’, ‘Why is there an agreement in certain areas?’, ‘Why does contradiction in views exist?’, ‘What does the agreement or contradiction show me regarding the theme?’ and ‘What do these show me about my research question?’ The interviews with the academics and students were analyzed separately and different conclusions drawn. Following this, these two sets of interviews were compared and brought together.

In the presentation of data analysis, the views of the academics and students were compared and categorized according to the themes represented in the conceptual framework. In doing this, the predominant concern was to make the data comprehensible and accessible to the readers. This was accomplished by drawing all the variations to the themes together, comparing as well as contrasting them. The responses in the interviews, relationships between them and the context they occur in were then described in a narrative form. The narrative style allowed for an exploration of the connections between the
responses, the context in which the educational change took place, thereby allowing for a more holistic discussion of each theme. Quotations from the interviews were cited to create a sense of immediacy, at the same time, allowing the reader to make evaluate the data and conclusions for him/her self.

Lastly, the researcher ensured transparency by informing the interviewees of the research purpose and questions. In addition, the interviewees were given a few weeks to consider if they wanted to participate in the study. Transcripts of what they said were sent to them a week after the interviews were conducted. They then verified if what they said was accurately recorded and returned comments via email. Consistency required that the researcher checked that the ideas and responses were consistent by examining the themes in one interview for coherence with the themes presented in others. In the case of this study, this was achieved by coding the interview data according to the themes being examined. Communicability suggests that it should be comprehensible to the readers, and that enough details and evidence are furnished for the text to be real (Rubin, 1995). This is accomplished through the presentation of interview data in the present study. Quotes of interviewee responses were given so as to give readers a sense of immediacy of the data.

Once the interviews with both the academics and students were analyzed, the data were compared with those gathered from documentary analysis, the last research tool used in this study. The same method of analysis was used for the documents. Finally, all the data were collated and compared. The sources of the data therefore came from academics, students and official documents. The following section describes consequently the procedure, strengths and weaknesses of documentary analysis and how this method was carried out in this study.
4.9 Documentary Analysis

This section discusses the justification for using documentary analysis as a research method, as well as its strengths and weaknesses. The three research methods, namely interviews, focus groups and documentary analysis, are chosen because it is hoped that the strengths of one method can compensate for the weaknesses in another.

4.9.1 Justification of Documentary Analysis as a Research Method

Documentary analysis is selected as a research method in this study in order to provide an official perspective of the motivation for the curriculum change. The viewpoints of the government and policies-makers on the curriculum change were then compared with the personal views of the academics. This comparison showed the similarities and differences between what the people at the top and those at ground level think. May (1997) described the uses of documents as having the potential to inform and structure the decisions that people make on a daily and longer-term basis; offering interpretations of social events; informing the goals and intentions of the events, and describing relationships. May (1997) indicated that right inferences must be made from the documents by taking into consideration context and perspectives of social events of the period in which the documents are written. This may mean an examination of several documents so that a comparison can be made, and a study of the historical period of the writing of the documents. The source of the documents is also an important factor here. In the case of the present study, all the documents examined were official and represented the voice of the authorities at the national and university levels. The reason for use of official documents was that these were the only ones available to the researcher. The researcher had been informed by someone at the management level in the School that permission
must be obtained if she wanted to examine unpublished documents from the School, but it was alright for her to use published documents from the library and websites. This means that the data collected from the documents represent the official statements on the purposes of the curriculum change. In the case of this study, this still serves the research aim since it allows a comparison to be made with the personal views collected from the interview and focus group methods. In addition, there are advantages of using this method that interviews and focus groups methods do not have.

According to Robson (1989), one of the advantages of documentary analysis method is that it is an unobtrusive measure. By this, he meant that the nature of a document is not affected by the fact that it is used for enquiry. Unlike interviews, the researcher need not be concerned that the data are tainted with the subjects saying things that will please him/her or are politically correct. The 'unobtrusive' nature of documentary analysis overcomes a weakness in interviews where the very presence of the researcher may affect the data collected. Secondly, the data are in permanent form, hence they can be subject to reanalysis, and allow for reliability checks and studies. Hodder (2002) described documents as evidence that survives physically. This is an advantage compared to interviews where the researcher has to co-ordinate a time schedule to meet and interview the subjects. However, it should be noted that the documents are originally not written for research purposes. While examining them, the researcher has to be aware of the original purpose they were written for. Documents should therefore be examined carefully, bearing in mind the weaknesses of such a research method.

Hodder (2002) claimed that documents widen the gap between the author and reader; leading to multiple interpretations. Words can say many things in different contexts; having the qualities of an artifact in that they are capable of transmission,
manipulation and alteration (Hodder, 2002). Written words, as a mode of communication, have a distinct disadvantage when compared with a face-to-face interaction. In a face-to-face interaction, there is the presence of non-verbal communication such as the tone of voice, facial expressions and gestures to verify the message communicated. With written words, such non-verbal language is unavailable. Written words are therefore prone to all kinds of interpretations and misinterpretations. This study therefore seeks to examine these communication problems by using methods that involve both verbal and written media.

The second disadvantage is that documents can be used and discarded, reused and recycled. It can ‘do’ different things through time: having the advantage over spoken words in that the writing down of words allows language and meanings to be controlled more effectively, and be linked to centralization and codification, having the ability to transcend context and gather new connotations through time (Hodder, 2002). Written words can contain ideology and be used as vehicles of ideologies. In using documentary analysis as a research method, it is therefore important to identify the aims with which the documents were written, and adopt a critical analysis of the text. It may also be very difficult to establish the initial purpose of the writing and how the information has been changed over time. The following section therefore describes the conduct of documentary analysis in this study in a way that takes into account these pitfalls.

4.9.2 Conduct of Documentary Analysis

The analysis method used on the documents was similar to that used on the interview transcripts. The stages consisted of coding; identification of themes; categorizing; looking at variables; counting frequency and examining use of metaphors. A qualitative approach was adopted in the analysis of the documents. This allowed the
documents to be examined in the context of the intended audience and purposes for which they were written, as well as the variations of the themes on the curriculum change.

Documents used in this study were mainly publications in the School such as annual reports, the university and School anniversary reports, vision plan of the University, newspaper reports of changes in university education as well as changes in curriculum in the university. Publications outside the University chosen for analysis included speeches by ministers in Singapore, documents on the economic plan of Singapore, a survey of Singaporeans' attitudes towards innovation, press reports and press release on Nanyang Technological University. The speeches by the ministers were obtained from the Ministry of Education website while the publications were all obtained from the libraries in the university. These speeches may or may not be written by the ministers themselves and are most likely edited before delivery at various occasions. It has been said that the ministers' speeches are written by scriptwriters and that the authors are not known. The following features of these documents are examined:

1. Date of the document;
2. Source, whether it is first or second hand information; solicited or unsolicited; edited or unedited and anonymous or signed;
3. Purpose of the document;
4. Content in terms of context of the information; internal criterion of the text; coherence in argument; observations and interpretation of the text and the match between theory and data contained in the document.
In terms of published works, most of these writings were secondary sources while the unpublished works were primary sources. The published works were written for public reading and edited. The documents were analyzed individually first for their perspective on the curriculum change, based on the themes of the conceptual framework represented in figure 3 (Chapter Three, p. 46). A comparison was then made amongst all the documents for consistency in perspectives and claims on the curriculum change.

The strengths of documentary analysis were therefore able to compensate the weaknesses in interviews. However, it also has inherent weaknesses and should be conducted with care. The next section therefore goes on to outline the generalizability, reliability and validity issues in this study resulting from the use of qualitative study.

4.10 Generalizability, Reliability and Validity

There are issues related to using case study investigation which a researcher should be aware of and strive to overcome. These have to do with issues related to research methods such as validity, reliability, generalizability and the position of a researcher. With regards to this study, these translate into questions of how findings of this case study can be generalized to other cases of educational change and how judgements can be made from the subjective views of people. There is also the issue of how conclusions can be drawn from the wealth of data collected and be objective.

It would be impossible to repeat a case study as every educational situation or context is different. Case study has to fulfill the conditions of reliability of results, which is the ability to repeat the original study using the same research instrument (Bell et. al., 1984 and Feagin et. al., 1991). In addition, the researcher herself is an academic staff member of the School in the university and it may be hard for her to distinguish her role as a member
of the University from that of a researcher. This also leads to the problem of making sense of a wealth of data, all of which are related in a complex way.

Both methodological and data triangulation are used in this study. Methodological triangulation allows for comparisons of viewpoints from both governments and individuals within the university. Data triangulation, in addition, enables the researcher to compare different individuals’ perspectives on the curriculum change.

For reliability, Burgess (1985) highlighted the benefits of using a triangulation of data collected from different methods in a case study. In the present study, this was achieved through methodological triangulation of both interviews and documentary analysis. The different methods used allow an exploration of the multiplicity of views (Burgess, 1985 and Bell et. al., 1984). The more the multi-methods differ, the more confidence can be established in the findings when they emerge in the different methods used (Lin, 1976). In the present study, a comparison was made between the between documents to see what similarities and contradictions exist regarding the curriculum change.

What the documents, academics and students said about the curriculum change were compared for triangulation of data. This process allows the researcher to focus on the research aim while not ignoring divergences from the central themes. This is however not a neat process as the researcher had to decide how the responses fit into the themes and relate to each other. In the last stage of data analysis, the researcher reviewed the data and developed a conceptual framework from the emerging themes. This conceptual framework was derived from the data. The researcher also developed more general and abstract truths about the implementation of curriculum change in Singapore and a theory from this which is presented towards the end of Chapter Seven.
Transparency is required not just in the research construct, but in the position of the researcher in the study. In this study, the researcher was a teaching staff member of the School although she was not an engineering academic herself. She taught the course, ‘Communication Skills’, to the engineering students, a subject that is termed ‘a soft skill subject’ by the engineering academics. It was a core course which the students had to take in their first two years of common engineering program. It is written that the researcher’s stand is affected by the position he takes in the structure and interaction (Sjoberg, 1967). The fact that the researcher was an academic member of the School meant that she had to make explicit how the findings would be disseminated. She was also requested not to reveal her subjects’ identity point will be further discussed in the section on ‘Ethics’ below. The fact that she was not teaching engineering courses helped the engineering academics interviewed to feel more at ease to confide in her the problems they faced in the engineering curriculum. This did not mean however that they confided everything they felt about it since she was still an employee of the School. In addition, in the course of listening to academics’ and students’ experiences with the curriculum she was affected by what she heard, particularly, with regards to problems they faced. Therefore, she needed to distance herself from the issues to take a more objective view of these issues. Again, these issues are discussed in greater detail in the next section on ‘Ethics’.

4.11 Ethics

There are ethical issues surrounding the subjects themselves, the position of the researcher in the School, her relationship with the subjects and how the findings are distributed, which necessitate certain actions. These issues were of concern to the researcher. As an insider in the institution being studied, there were implications on her
dual role as employee and researcher, and the effect the research might have on the academics, their work, and the students. These entailed steps to be taken in the process of the study which this section will discuss.

An ethical issue involved in case study research concerns the welfare of the researched both in the process and dissemination of the study. In this case study, a qualitative method was used, which involved investigating the situation and perspectives of members of an educational institution, and this meant that the study might affect its participants. Simons (1989) emphasized the importance of participants having some control over the process, form, and whether dissemination of this information. In the case of this study, this meant that consensus had to be sought regarding access to participants and documents; conduct of the study and dissemination of the information. This necessitated approval from the authorities concerned, Dean and Sub-Deans, as well as members participating in the study, namely, lecturers and students. This was important as the study evaluated an innovation in the curriculum, and the findings have repercussions on people at different levels: heads of department, lecturers. In addition, pupils and parents of pupils might also be affected by the publication of such information. It was important therefore that dissemination of information was discussed with members of the institution and agreed upon. It was also important that the methods of conduct of study, interpretation and analysis of data were made explicit to participants and other members who might be affected by the nature of the study in the institution. The dissemination of information is an important consideration in educational research, as there may be consequences for other professionals in the system, and other audiences have a legitimate interest in what professionals do (Simons, 1989).
The greater power the researcher had over the students involved meant that she had to ensure they were empowered with a choice to participate in the study. The power or status differences between the researcher and researched can have an effect on the latter’s agreement and participation in the study and therefore the results. Since the researcher was also a lecturer in the School, she was in a more powerful position than the students. It had to be made clear to the latter that participation was on a voluntary basis. Therefore, explanations of rationale, purpose, conduction and dissemination of the study were given to them. They were also given a chance to check on interpretations of data gathered from interviews conducted. Full information has to be given to the subjects, though complete information may not be possible, such as the statistic treatment of the data, adequate information must be given in terms of explanation of the procedures, benefits and risks to be expected, and reassurance given to answer any inquiry or for the subjects to withdraw from research if they so wish (Cohen and Manion, 1994). Lastly, subjects should fully comprehend the nature of the research, including the procedures and all the risks entailed (Cohen and Manion, 1994). This informed consent is an important principle to adhere to and forms the basis of the contractual relationship between the researchers and researched (Cohen and Manion, 1994).

How researched material is presented and disseminated is an important ethical consideration. The use of interviews leads to a close association of those being studied and an involvement in the events or issues being researched (Burgess, 1985). This is especially the case in the study, as the topic verges on curriculum matters of the School, work done by members within the School, students who are subject to the curriculum changes as well as their parents. Anonymity is not a solution here because it is almost impossible to maintain anonymity (Simons, 1989), and because if the report is impenetrable, the research
does not provide feedback to those researched (Burgess, 1985). Nevertheless, there is a need for trust in the integrity of the researcher (Burgess, 1985, Kemmis, 1983, Nisbet, 1970 and Neuman, 1997). This is especially true here as the researcher is also an academic staff member in the School, and the colleagues may be fearful to reveal information that will threaten their positions. This may set limits to the data gathered, which means that in the description of methodology, the researcher has to be very explicit about her position in the School and how this may affect data gathered in her role as a participant observer.

The second issue concerns the role of the researcher in his/her data-gathering process (Lin, 1976). In the case of this study, the researcher was a member of the institution, but in a sense she was also an outsider, as the innovation mainly involved changes to the engineering curriculum, and she did not teach any of the engineering subjects. For this, the engineering lecturers and students might be willing to express their views with a little more freedom, and find comfort in having a listening ear once trust and rapport are built between researcher and participants. It is therefore important in case study research that the researcher is explicit about his/her position or role in the institution, relationship with the participants of the study and other factors s/he may be aware of that will influence his/her interpretations.

In the context of this study, much of educational policies and changes are decided by external bodies like the Ministry of Education and Ministry of Manpower and are governed by the economic needs of the country. This may affect the willingness of subjects to participate in the study, as they may question if a study of the innovation will serve any purpose since they are somewhat powerless in the decision-making. They may also be fearful of the repercussions on their positions. This meant that time was needed to negotiate access to data, as well as co-operation from participants. Particularly in
 qualitative research, there is a problem of bias due to assumptions and personal beliefs of
the researcher, but rather than claiming to be objective (as in the case of quantitative
research), the researcher has to be explicit about his or her values (Neuman, 1976). In
addition, it is 'internally justified' to the extent that it makes accessible the invention of the
study (Kemmis, 1983).

Due consideration of ethical issues is therefore important at every stage of the
research process. For this reason, the present researcher sought approval from relevant
authorities, namely the Dean and Academic Dean of the School and the interviewees. In
addition, the present researcher made the process of research explicit to the subjects as well
as other members of the institution who might be affected by the dissemination of the
findings. She transcribed all her interviews with the academics and emailed them her
transcription and summary of the interviews. The interviewees then responded to say if her
transcription, summary and interpretation of what they said were correct. For the students,
the researcher reported verbally to them the findings she gathered from the focus groups
discussions. In addition, the researcher reported to her Dean the progress of her research
and her findings at her annual appraisal with him. By making the research process
transparent and explicit, it increases the validity of the research, as the process of the
research is more apparent to the readers and the ethical issues well managed.

This research is therefore a qualitative study of curriculum change. Interviews and
focus groups methods were selected because they allowed the curriculum change to be
studied in its relevant context, and for an examination of people's views as well as social
relationships. Documentary analysis was chosen because the official documents selected
represent the perspectives of the authorities and policy-makers. These methods are
complementary in the sense that the strengths found in one compensate for the weaknesses of another. A triangulation of data was then carried out through a comparison of the data collected from each of these methods. The perceptions of different categories of respondents were compared. Therefore, both methodological and data triangulation were carried out. In the conduct of these methods, certain ethical issues were also addressed. This chapter has discussed the characteristics of the research approach. The next chapter proceeds to give a report of the data collected with the use of these methods.
CHAPTER FIVE

PERSPECTIVES OF THE CURRICULUM CHANGE: PRESENTATION OF DATA

5.1 Introduction

This chapter presents data collected on academics' views of their involvement in a curriculum change in the engineering program. The issues examined were firstly, academics' perspectives of the motivation of the curriculum change, secondly, what organizational structures existed to facilitate their input and involvement of the change, and lastly, their participation in implementing it. It was assumed that the factors found in the conceptual framework represented in Figure 3 in Chapter Three (p. 46) had an effect on academics' responses to the change. Through interviews carried out with the academics, it was possible to find out how these factors influenced their level of understanding of the change, commitment and ownership of the change. Consequently, it was also possible to see how their understanding and commitment caused them to make adjustments in their teaching.

The findings were derived from documents and interviews conducted. A qualitative approach was chosen in analyzing the contents of the documents and interviews as this study sought to understand the people's perspectives and the motivation for change. Documents consisting of ministerial speeches and the University and Staff Digest issues were examined in search of the rationale and motivation for a broader engineering education, both at national and university levels. In addition, two research projects done by the academics in the present School, as well as other published works on engineering education, were examined. These documents provide a broader view of educational
change and role of the university in the economic growth of Singapore. The interviews complemented this and provided more focused data on the academics' view of the change.

5.2 Presentation of Data

The findings in this chapter are organized according to the factors found in the model used in this study which is represented in Figure 3. Therefore, Section 5.3 presents the data on the organizational factors affecting academics' responses to the curriculum change. Section 5.4 goes on to explore the extent of their involvement in the implementation process. Following this, Section 5.5 investigates their responses to the change based on the degree of their knowledge and involvement. Section 5.6 then examines the curriculum diffusion as discussed in Chapter Three (p. 29), or what actually takes place in the implementation of the change. Lastly, Section 5.7 explores the academics' adoption of the change and changes in their teaching approach.

In addition, this chapter presents the data gathered from focus group interviews carried out with Year 1 and 2 students in the common engineering program in the School. Students' views were crucial as they were the recipients of the curriculum and teaching. Their perception of the goals of the common engineering program as well as learning experiences could help to shed light on how the curriculum was actually working out. They could also comment how the change in the common engineering program had resulted in a change in their learning experiences, outcome, and whether these changes were positive or negative. This feedback, coming from the students, would be important for the Academic Board in terms of revising the curriculum. Lastly, the data collected from these interviews were compared with data from official documents on this curriculum change. An account of what the documents claim to be the motivation, purpose, goals and expected outcomes
of the change are presented. In addition, the source, data and authors of these documents were examined so that deductions about which perspectives these documents represented could be made. This also allows for an analysis of consistency of arguments between these documents. The sections below report and compare data collected from documents, interviews with academics and focus groups discussion with the students.

5.3 Organizational Structures and Effects on Academics

This section presents the data from documents and interviews on academics’ knowledge in the change as well as the organizational structures present to facilitate these. With regards to academics’ knowledge, this section reports their awareness of the motivation, purpose and goals of the change.

5.3.1 Academics’ Knowledge of the Motivation for the Change

In Chapter Two, the political and economic situations that drive educational changes in Singapore were reviewed. It was highlighted that academics undergoing certain educational changes may or may not be aware of the specific economic factors influencing certain educational changes. Therefore, this section examines their awareness of the motivation for the broadening of the engineering curriculum. The assumption in Figure 3 illustrated in Chapter Three (p. 46) is that the national factors giving rise to a particular educational change influence the kinds of organizational structures in the university, which in turn affect the academics. This study therefore compares reports of this motivation found in the official documents and revealed by academics and students interviewed. The source and contents of the documents were first examined, followed by a comparison with the interview data.
The role of the universities in the economic development of Singapore was described in the publications, *The Strategic Economic Plan, Towards a Developed Nation* (1991), *Committee on Singapore’s Competitiveness* (1998), as well as two speeches by the ministers in Singapore, *Speech by Minister for Education, RADM Teo Chee Hean* (1998), and *Speech by Dr Tony Tan, Deputy Prime Minister and Minister for Defence* (2000). Both the publications were prepared by the Ministry of Trade and Industry, Singapore. The authorship of both publications was established to be the Ministry of Trade and Industry and the specific authors were unknown. The national aim of higher education in Singapore was presented in the ministerial speeches. This shows that the publications represent the official views of the functions of the universities in Singapore and outline what the government hopes to achieve.

The Minister for Education mentioned that university education would be expanded in conjunction with a broadening of the curriculum (*Speech by Minister for Education, RADM Teo Chee Hean*, 1998). Dr Tony Tan felt that the training in both Universities in Singapore should meet the economic needs (*Speech by Dr Tony Tan, Deputy Prime Minister and Minister for Defence*, 18 Dec, 2000). The Universities play a key role in imparting and applying knowledge in support of national objectives and to do this, the curriculum has to be flexible and innovative (*Speech by Dr Tony Tan, Deputy Prime Minister and Minister for Defence*, 2000). With regards to the field of electronics engineering specifically, greater and possibly, more rapid changes are predicted in the global economic scene. According to the publication, *Committee on Singapore’s Competitiveness* (1998), in 1998, unpredictable global economic changes, such as a slowdown in Singapore’s export to the U.S. due to a sudden downturn in global electronics industry, caused Singapore’s share in US electronics market to drop. Mr Lee Hsien Loong,
the Deputy Prime Minister of Singapore, pointed out that the whole electronics industry is in ‘perpetual revolution’ (Lee, 1966, p. 3). It was pointed out that competition for Singapore is now fiercer and she can either adapt or become irrelevant (Lee, 1966). Since industrial development is unpredictable, graduates therefore need to be trained to be flexible.

There is a consistency in the official statements about the role of Universities in the economic development of Singapore as well as the reason for the broadening of their curriculum since 1998. It was hoped that such a broad-based curriculum would develop in students skills like flexibility, innovativeness and initiation in demand in industries, and ultimately, vital for the country’s economic development. These official statements explaining the motivation for the curriculum change were then compared with the academics’ and students’ views of the change.

The chief factor motivating this curriculum change is the fast-changing economy. In addition, technology is changing rapidly and the engineering field is therefore becoming more complex. In the interviews conducted with the management level academic staff, the Vice-deans, Head of Division, Program Director and Curriculum Committee member identified training engineers in skills such as flexibility, adaptation and ability to learn new skills as being crucial. A Vice-dean interviewed revealed that the decision was made by the President and the Management Committee, who had been observing the trend in economic and technological changes in Singapore over the past years. As one of the Vice-deans explained:

The key motivation is that growth in engineering is becoming more complex than before, complicated or complex problems, much more multidisciplinary. Whereas before engineering was much more focused, not for people to work together, it’s much more multidisciplinary, how to adjust their specialization. (VC1, Appendix III, p. 221)
Another Vice-dean pointed out that:

There are several schools of thought in industry. I mean, there are industries that feel that with a broader based education, they are more adaptive, they are more flexible. (VC2)

These comments showed that the Vice-deans were fully aware of the changing expectations of industries that spurred this curriculum change. They knew about the skills in demand in employment that resulted in a need to change the curriculum. The University received effective communication of the skills demanded by the industries, and felt an urgency to adapt accordingly. As shown in Figure 3 in Chapter Three, it would appear that communication of the top level of policy-makers with the management level of the university had been quite effective.

The academics interviewed, who were also course coordinators, described the change as a top-down decision, originating from the government. One of these interviewees stated that this change to broad-based curriculum stemmed from the need to increase competitiveness in future international market, and train engineers to survive better in the future with the demand of new skills. Another interviewee explained that Singapore was moving towards a ‘high-tech economy’ and people had to adapt to changes in the situation very quickly. In addition, they needed to know many areas of knowledge as businesses were also becoming multi-disciplinary. As one course coordinator explained:

They think that it would be more suitable, because we're going into a high-tech economy, so basically people need to adapt to changes in the situation very quickly, and therefore they need to know a lot of different areas, rather than focused on just one area. If the old economy changes, then something else becomes fashionable, and the people won't be able to adapt so easily. So they want graduates to know a little bit of everything. I think nowadays, business becomes multidisciplinary, so therefore, they think that if graduates know about different things, they will be able to come up with new ideas. Different knowledge, then produce some interesting outcome. I think that's the basic idea. (CC)

According to the academics, there were three categories of needs resulting in this broadening of the curriculum. Firstly, there was a need to train students in diverse skills relating to different disciplines. Secondly, the working relationships in organizations had
changed such that people had to work in teams and with people of other disciplines. Thirdly, it was vital to train students to meet and adapt to external changes, thus the need to train them to be flexible.

There is a consistency in the documents and interviews about skills needed by the economy. The academics' views reflect those found in the documents, namely, that it is global economic change that motivated the curriculum change. The academics added that it was the change to multidisciplinary work that necessitated a broadening of the curriculum, an explanation not found in the official documents. In summary, the key word is 'adaptation' and the curriculum therefore has to train the students to gain this skill. In reference to Figure 3 (Chapter Three, p. 46), the interviews showed that the academics were aware of the changes in the national economic scene, though they differed in their opinions about the changes in the curriculum to produce the desired skills in students. The next section therefore goes on to discuss academics' knowledge of the purpose and goals of the change.

5.3.2 Academics' Knowledge of the Purpose and Goals of the Curriculum Change

As reflected in Figure 3 in Chapter Three, the academic's knowledge of the purpose and goals of the curriculum change influenced their responses to it. The purpose of the curriculum change was identified by the academics as preparing the undergraduates for a knowledge-based economy. The move to a knowledge-based economy globally, and in Singapore, makes it necessary to train students in diverse knowledge. The belief that education needs to change in accordance to economic change seems to fit Blenkin's et al. (1992) concept that change is an inevitable feature of adaptation to a fast changing environment. It also follows the line of the thinking that changes in education are
necessary to help students adapt and survive in their ever-changing environment. This section presents information found in the publications examined that identified the skills needed to function in a knowledge-based economy and the changes needed in the education system to train students in these skills. This need to tailor the education system to train graduates to work in such an economy was also raised by one of the academics interviewed.

Dr Tony Tan, the then Deputy Prime Minister, described the knowledge-based economy as one that is driven by ideas, innovations, intellectual property and information (Speech by Dr Tony Tan, Deputy Prime Minister and Minister for Defence, 2000). Entrepreneurship and innovation were identified to be the key to economic success now (Lee, 1966). The importance of increasing manpower capabilities is realized as Singapore now has to compete on the basis of capabilities rather than costs (Committee on Singapore's Competitiveness, 1998). These ministerial speeches were obtained from the Ministry of Education website. They were also dated between 1998 and 2000. The realization of the global change to a knowledge-based economy, and unpredictable changes, began in the mid-80s, lasted till 2000 and the present. This shift to a knowledge-based economy has serious implications on higher education since it now plays an even greater role in inculcating students with the needed skills of innovativeness and ability to generate knowledge. The School of Electrical and Electronic Engineering therefore felt very strongly the need to teach students to be innovative.

According to the NTU Annual Report, this change to a two-year common engineering program is to equip graduates to seize new opportunities, as they will be able to apply new technologies in unfamiliar situations, and innovate (New Dimensions, NTU Annual Report 2000-2001). In addition, students take subjects like management, IT,
economics, law, and communication skills to give them a broad spectrum of skills, and in their second year, they had to take a limited number of subjects in their specific disciplines (New Dimensions, NTU Annual Report 2000-2001 and Nanyang Technological University. Beyond 20 Vision Plan, 2000). The aim of this curriculum change was also to prepare graduates to face a new working environment of technological changes and inculcate in them an attitude of lifelong learning, in acquiring, constructing and applying knowledge in work-related context (New Dimensions, NTU Annual Report 2000-2001 and Nanyang Technological University. Beyond 20 Vision Plan, 2000).

The University’s annual report is published on an annual basis and circulated to the staff in the University. It helps to inform the readers about the purposes of the curriculum change. The circulation of publications, however, only serves the function of relaying information. In itself, it is inadequate in terms of eliciting feedback from the academics or providing the avenues for interaction on the issues involved in this change. One of the academics interviewed revealed his thoughts on this tailoring of the curriculum to the skills needed in a knowledge-based economy. This section also presents the problems involved in making the curriculum change from the viewpoints of the academics interviewed.

An academic who was the Curriculum Committee member perceived the motivation for this change as coming from:

It’s a drive to a knowledge economy, knowledge-based economy. As I said, no one can say by the time you graduate, no one can say what the world will be, what kind of knowledge will be relevant, and basically, a person needs to be learning constantly. (CC)

From these comments, it can be gathered that the goals of this curriculum change are to prepare students for changes in future work. These changes consist of firstly, the nature of work itself which has evolved to be more multidisciplinary; secondly, the expectations of industries for graduates to possess certain skills, and thirdly, the
unpredictability of the environment in terms of the kind of knowledge needed to survive economically.

The academics who were course coordinators felt that in view of the changing external circumstances, this move to a broad-based education was the right direction to take, while three of the academics who were course lecturers revealed that there were problems for the students in this change of curriculum. One of the academics exerted that:

> My personal belief is that you’re making the students a little more confused, if I may say so. I think one year common engineering is very good where they get some idea of engineering rather than electrical and electronic. Now they have to learn Biological Sciences, they have to learn Physics; they have to learn Mechanical, Civil, Materials. So most of the students whom I have met in that group, they are not very happy because they like to learn focused things, you know subjects they are interested, rather than forced on them. ‘I think we should not impose these courses on them. We should have some core courses. What we have now is everything is core in the common engineering. We should have some core courses, and we should leave some flexibility for them, to exercise their option. (Co4)

This academic felt that it was good to get some knowledge of each field of engineering, particularly in the first year. He also felt that students wanted to specialize in a particular discipline of engineering. A few issues emerged here. Firstly, there seems to be a mismatch of students’ expectations of learning and what the curriculum planners hope to achieve in them. Secondly, a certain number of students and academics felt that to have students acquire a little knowledge of different disciplines was not very useful. They did not seem to understand the direction that this was taking them. Lastly, the interviewee felt that the students could benefit from the freedom of choice about the courses they wanted to study. At the moment, all the courses were prescribed, resulting in frustration amongst the students who felt they would like to make their own choice. Both the academics and students did not seem to be adequately aware of the purpose, goals and expected outcomes of the curriculum change. Another course coordinator pointed out that students were now struggling with courses that they had no background in. This posed a big problem to their learning.
The Program Director raised a similar problem:

Because in my opinion, the course is not very intense. They're diluting it even further now. It may give a broad based education, no doubt, but the students lose out in terms of electrical engineering per se. (PD)

This comment points to a need in curriculum planning to balance between breadth and depth in the curriculum. This interviewee felt that what had happened was a 'dilution' of the curriculum resulting in inadequate specialization. This is an important issue in terms of firstly, what students and academics expect out of university education and the proportion of broad-based and specialized training. Their expectations obviously have an influence on their perception of the value of their training. Secondly, there is the pragmatic question of what employers expect out of graduates with a degree in Engineering. This seems to be a predominant question in the minds of both the students and academics interviewed.

The academics, however, have their personal views of what broad-based education means. One of the academics felt that students should also do more of non-technical subjects like Human Resource Management and Accounting since these were skills needed in the workplace. Another academic felt that what was important were problem-solving skills since students did not transfer most of what they learn to their jobs. Analytical and critical thinking skills were also more important. For this reason, one course coordinator and two course lecturers pointed out that projects were very important for students as employers evaluated their abilities from their performance in these tasks. Yet another academic explained that the academics' delivery of courses, too, made a difference, and saw her role as motivating students to engage in critical thinking.

Though the academics were vaguely aware of the general motivation, purpose and goals of the curriculum change, they were doubtful that it produced the desired learning outcomes. Their main areas of concern were, firstly, how the change was introduced and
secondly, how the problems involved in changing and teaching the courses were being considered. This shows that they wanted improvement in the organizational structures and the process of implementation of the curriculum change which were the two key factors affecting academics’ responses as illustrated earlier in Figure 3. Secondly, they desired more bottom-up communication approach of the problems they faced in implementing curriculum changes. Implementing the curriculum change to produce the desired learning outcomes of flexibility, innovativeness and multidisciplinary skills was therefore not as simple as it seemed. It appears that more planning needs to take place to achieve the educational aims described by the Committee on Singapore’s Competitiveness. The next section therefore goes on to discuss the nature of this change in the curriculum in terms of the change in the contents of the courses and the implementation process.

5.4 Academics’ Involvement in the Change Process

Academics’ involvement in the implementation of the change is a key factor governing their perception and attitude as shown in Figure 3 in Chapter Three (p. 46). Both Vice-deans interviewed felt that the academics had generally accepted this change though there was a diversity of opinions due to their different backgrounds. These differing backgrounds resulted in varied expectations of what students should learn.

Another problem, as raised by the Head of Division, was inadequate time given for academics to discuss the change. One of the course coordinators said that his team worked independently to execute the change and there was no clear leader setting the direction for the change. All the coordinators interviewed said they worked collaboratively and the teamwork amongst them was good.
The interviews also sought to find out the academics' responses on the process of implementation of the curriculum change. In the course of the interviews, the interviewees described the process of implementation of the change based on their involvement at the various stages of the implementation process.

The process of implementation of this change consisted of several stages as described the Vice-dean interviewed. He said that the decision was probably made at the top, by the President, Deans and Academic Committee. A committee, or what the Vice-dean called ‘taskforce’, was then set up to implement the broad-based curriculum. This committee drew a draft of this change which was delivered to the various Engineering Schools by their respective Vice-deans. This draft was then reviewed by the Schools’ Curriculum Committees. Each Division in the Schools then discussed changes to specific subjects and handled the details of which topics to include or exclude. Their plans were then resubmitted to the Curriculum Committee, which includes the Dean, Head of Division and Directors of Masters program. The Vice-dean asserted that this is an ‘iterative’ process, meaning the plans go in cycles from the bottom to the top level to be reviewed and approved. The two Vice-deans and one Head of Division interviewed explained that this first attempt did not mean it was going to be the last as the curriculum would be subject to further review. Secondly, that they could not wait for a perfect plan to emerge before implementing the change as technology was evolving too fast for them to wait. A head of division explained that at the division level, small groups of teaching staff were formed to look at changes in specific subjects. They reviewed each subject in the light of first to fourth years, since they had to ensure that students taking the subject had sufficient background from previous years.
A Vice-dean used the metaphor of ‘cooking’ to describe this process of implementation of the change:

Nobody knows the exact recipe about what to cook. It’s like cooking you know. I will cook it differently, you will cook it differently. And even if it is the same, the person who tastes it will think one is worse off. It is a very complicated thing. Everyone thinks their recipe is the best one. And even if you get two recipes which are identical, you get two persons tasting it, alright, they will think it differently. It’s a matter of expectations of what we think students should learn and also what the students themselves think what they should know in today’s knowledge-based economy. (VC2)

The Vice-dean likened the choice of courses to include in a curriculum to cooking. He explained that different academics would recommend different combinations of courses to include but ultimately it was preparing students to face the knowledge-based economy that was important. The Vice-dean pointed out that there was always a divergence of views from the academics based on their different expectations of what was important for students to learn. However, the overarching goal of preparing students for the workforce took precedence over these views.

Many of the academics who were course coordinators and course lecturers expressed that the change happened suddenly and by the time they received the news, they were expected to implement it. There was no consultation with them as to whether they agreed in principle to the change. All the academics who were course coordinators and course lecturers pointed out that feedback should be gathered from the teaching staff and students. The reasons offered were firstly, the teaching staff was the ones who had the pedagogical knowledge, as well as knowledge of the students. Secondly, a discussion of the change would result in greater commitment on both staff and students. Thirdly, it would also result in the change taking place more effectively. Lastly, the academics felt that they should not be taken by surprise or be imposed on. One of the course coordinators expressed:
But perhaps maybe, more consultation is needed to clearly explain to us the rationale, at least through a proper channel, why these are the changes that the school and university want to implement. In fact, I read about the 'T' man, the interview, from the newspaper. In fact a lot of news we come to know about it from the newspaper. (CO3)

An academic who was the coordinator of a first year engineering course emphasized:

The implications are that we are doing what we are told to do that we may not completely agree with it. So the implications are sometimes you may not do it wholeheartedly, because you may not believe in that. So, from the students' perspectives, they also don't believe in that. Their views were not taken, so they just go to the classes, they just cram things, you know. They just want to get by. (CO4)

From the feedback of the first academic, the purpose of the curriculum change was not clearly communicated to the academics and this, according to the second academic, caused them to lack commitment and ownership to the change. It seemed that the external communication of curriculum change was more effective than the internal. These comments also showed that academics views were not adequately incorporated in the decisions, plans and implementation of the change and they were consequently not involved at the decision-making level. This also gave rise to feelings of frustration amongst the academics who rightly considered that their professional judgement and input should be sought on this.

There were varying reports on who initiated the change. One course coordinator thought that the Vice-deans must have sat down with the Dean of College of Engineering while another thought that the Vice-dean for Academic Studies must have come up with a structure for this change, yet another coordinator thought that it came from the Head of the Curriculum Committee. When asked if they had recommendations to make to the process of implementation, two of the course coordinators confessed they did not know how the process could be done differently. As explained by one course coordinator:

If you talk about a change in syllabus, then surely it was a very painful process, one of the problems, is that it has been the habit of our university, or our school, that they want to avoid mistakes, and I can even say, they're afraid of mistakes; and for a big change like this, it's difficult to foresee what's going to go wrong. It's not some minor adjustments, it's change of the whole curriculum, so people just try to imagine things in their heads, before they see it. And technically speaking, I cannot see how the change can be
simpler, but basically, it seems everything is changing, because of the new two years common engineering. (HD)

According to this academic, there was a certain degree of risks and learning through trial and error in implementing change. He said that there was also no way of guaranteeing outcomes before the implementation. He pointed to the complexity of implementing the change and it was obviously difficult to seek feedback from the large population of students and staff on a change as large as this. He felt that the process was made more difficult by the University's need to have a perfect plan. It was unrealistic to have perfect plans regarding educational change that is a complex phenomenon involving people (Chapter Four, p. 40).

Regarding the direction of this change, the same coordinator perceives that this change was meant to be long-term, though, he stated, a change could be considered long term in the University but things could change again when something else happened. Another academic felt, however, that the curriculum had to be updated and modified. He claimed that this change was only part of this continual process of revision of the curriculum.

All the engineering academic staff interviewed claimed that the effectiveness of this broad based curriculum could only be evaluated over a period of time. They have to wait for the first cohort of students in this program to graduate and enter the workforce before knowing the outcome. All of them concur on the point that the ultimate judges are still the employers. According to one of the Vice-deans, this outcome can be evaluated by the responses from the students, receptivity of employers of the students' skills, and academic monitoring.

The best we can do today, so you have to continue to evaluate the outcome of this change in various ways. Academic monitoring is simply one of a number of parameters. You can't simply say a program is
successful because students score a number of As.' The end judge is still be the people who hire our students, whether they think they should be broad based. (VC1)

This comment shows that the University sees a chief aim of the curriculum as training students in the appropriate skills demanded by the industries. Industries' reception of the change seems to be the ultimate judge of its success, above academic monitoring. It can be argued that this is a rather pragmatic view of education. At the same time, however, it is also important to pay attention to the processes of change, teaching and learning.

Three academics who held positions of program director, head of division and curriculum committee member, described the implementation as a consensus-building process. They explained that there were discussions at various levels of the Schools' hierarchy on what to include on the new curriculum. According to one of the Vice-deans:

Ultimately there was a lot of consensus. There was a lot of debate, if some parts should be left off, ultimately when it was put down, there was a general consensus, yes. (VC2)

There was a fair degree of compliance on the academics' part in implementing the change. The 'debate' here refers to discussions about topics to include in the syllabi. The Vice-dean felt that when it comes to implementation, everyone co-operated.

With regards to teamwork, the academics interviewed felt that his team had managed to gain a consensus about the changes to make to their course syllabus. The working relationships among the teams of academics were good and this was a strength that gave them the support they needed to make the changes. An examination of social relationships is important here as the literature shows that positive relationships can help academics cope with the role diffusion and strain of the change (Chapter Three, p. 36).

When asked what recommendations they would make to improve on this process, a professor interviewed raised the importance of looking at the curriculum objectives first and base decisions as well as actions on these objectives. He emphasized that people from
outside the educational institution could give advice but people inside should be the ones to do the planning.

The process of implementation of this curriculum therefore began with committees at the top level and decisions were then disseminated to committees at various levels of the university's hierarchy to those teaching the courses. It can be seen that the problems resulting from this method of dissemination are found in inadequate involvement and communication for those at the bottom level. The next section therefore discusses the responses from the interviewees regarding the state of communication in the implementation process of the change.

5.5 Academics' Perception of the Communication Processes

One of the areas this study examines is the effectiveness of communication in the dissemination of the curriculum change from the policy-makers to the academics. The arrows in Figure 3 (Chapter Three, p 46) shows, therefore, the influences of one factor on another as well as the communication taking place. One of the questions in the interview instrument aimed to find out is the kind of channels of communication utilized to relay news of the change to the academic staff, as well as the effectiveness of the communication that took place. This section examines the effectiveness of communicating the purpose and goals of the curriculum change to the academics and students.

The Program Director and the Curriculum Committee member revealed that there was a lot of debate regarding this change but ultimately the academic staff came to a consensus. The Curriculum Committee member explained that the syllabus was planned with the academics' input but the degree of their involvement was dependent on when they joined the School when the discussion was going on. The channels of communication by
which the coordinators first learned of this change varied from emails to meetings in the
division. A few of the academics had vague recollections of where they first heard of this
change. One of the course coordinators even confessed that he first learned of it in the
newspapers while another said he heard it informally from colleagues. In all the cases, they
claimed that the decision was made by the time the news came to them, and their job was
to execute the changes. Two of the interviewees, namely, one course coordinator and one
course lecturer, emphasized the need for meetings to brief and elicit feedback from the
academic staff members:

I think the School should call for a meeting, because this is quite a big thing right? To change it from one
year to two years common engineering, and it affects everyone, either staff teaching in lower or higher
years. 'Perhaps we need to have a dialogue session, to explain the rationale and to seek feedback from
the staff. In fact, in the dialogue session, I cannot remember if there's an email there, there is a folder
there for people to comment. But that comment is for the subject, not so much for the policy, why these
changes are implemented. (CO3)

This shows the academics' desire to be involved in the decision-making about
curriculum change. The lack of such a participation resulted in subsequent lack of clarity
about goals and purposes of the change for the academics and students. Understandably, it
led to a lack of commitment as well as concerns on their part about such a change. The
academics in this interview pointed to a number of problems in the implementation of the
change. Firstly, there was ineffective internal communication within the University. The
first academic interviewed stated the importance to have more channels of communication
for the academics to understand the rationale of the change. He confessed that he first
learned of the change through the newspaper, showing that the communication going out
of the university was more effective than within it. Another academic explained that when
academics did not have a say in a decision, and were told what to do. As they failed to
believe in it, students too did not believe in it. This shows that participation in decision-
making is crucial in getting people's conviction and commitment to a change.
Regarding the goals of the change, two of the academics who were course coordinators stated they were unaware what these were, and pointed out that there was no official document on this. They expressed that the change happened quite suddenly and one academic stated that the academic staff were apprehensive about giving feedback as they were uncertain of how it will be received.

In terms of source of information, a number of the students interviewed claimed they first heard of the two-year common engineering program from their contemporaries. Others discovered the change in the newspaper or through family members as late as after they entered into the University. Two of the students interviewed recalled having attended a briefing in which they were told of this change to a two-year common engineering program while the other students could not recall receiving an explanation.

The channels by which the academics and students received the news about the change were all different. One thing was certain, by the time they heard of it, they were expected to make the stipulated changes to their courses. The academics expressed a greater desire to voice their views on the change and be involved in the decision-making process. The process of communication took place according to the hierarchy of the university, from the top levels to the bottom, based on the tasks that had to be executed. There is a need to improve on the communication process so as to help the academics implement the change more effectively.

5.6 Academics' Responses to the Curriculum Change

As discussed earlier in Chapter Three, Figure 3 assumes that the academics' knowledge of the nationwide circumstances motivating the change, and their involvement in it, guide their responses to the change. One of the questions this study addressed was
how the academics’ knowledge of the change led to their perception, belief and attitude towards it. This section presents the academics’ views on the change to the engineering curriculum. Much of their responses to this change centred on industries’ reception towards it, though there was a mixed view of what industries’ expectations were. This resulted in a debate on whether the engineering curriculum should have more breadth or depth and the academics were divided over this.

According to the *Committee on Singapore’s Competitiveness* (1998), there are three areas of the educational curriculum that need to be changed to adjust to economic changes. Firstly, the content of the curriculum has to equip students with skills in resource planning and allocation, interpersonal skills and working with information (*Committee on Singapore’s Competitiveness*, 1998). Secondly, the examination system has to be reviewed so that it can help students focus on understanding rather than rote learning (*Committee on Singapore’s Competitiveness*, 1998). Thirdly, there should be greater flexibility and diversity in the syllabi to inculcate broader talents in students (*Committee on Singapore’s Competitiveness*, 1998). Teachers are also encouraged to move from an assessment system that rewards one fixed answer to one that reinforces initiative and resourcefulness in students since it is hard to predict the nature of future jobs (*The Strategic Economic Plan - Towards a Developed Nation*, 1991).

From these recommendations, the emphasis is no longer content but skills, particularly a spectrum of skills. These criteria can be compared with those recommended for engineering education in general. The guidelines for engineering education recommended a balance between teaching fundamentals and giving students a diversity of multidisciplinary courses (Ditcher, 2001). The curriculum must prepare students for both engineering and non-engineering professions, because when engineers are promoted, they
move from technical to more management work (Sng, 2001). This means that making a
curriculum change in an engineering program involves maintaining this balance. The
tensions resulted are due to the need to train students in these diversity of skills. Such
tensions are reflected in the responses given by the academics interviewed.

These tensions were therefore created by having to achieve breadth and depth in the
engineering curriculum. Breadth in the curriculum meant sufficient scope in terms of
multidisciplinary courses. Depth referred to adequate specialization in particular strands of
engineering. In an interview, an academic who was the program director of a Masters
program gave the following response with regards to the curriculum change:

You mean the curriculum change. It seems to be an immediate change. But in the light of experience,
there may be more modifications to the change later on. That may happen, but we don’t know right now.
One thing just occurs to me, in the context of the employability, and the direction of the employers, now, it
seems the vertical part of the ‘T’, which is to specialize very well in the subject, which is the demand of
the market. Maybe their employability will be fine. The difficulty is to identify which is the area that will
change. And that’s always a problem with specialization. (PD)

Concern about employers’ attitude towards the broad-based versus specialization
debate is reflected in this remark. This interviewee pointed out that the problem with
specialization was that technological development and the areas of technology in demand
in the market are unpredictable. The difficulty had to do with keeping up with
developments in technology and knowing what to teach students. It may also not be
possible to teach students all the advancements in technology since this was too vast and
secondly, by the time the students got through the four-year course, what they learned
might be outdated.

Four of the interviewees thought that the motivation for this change was to train all-
round students, or what the university coined ‘T’ graduates. The horizontal line of ‘T’
stands for breadth of knowledge, while the vertical line stands for depth. Both the course
coordinators and course lecturers felt that it is virtually impossible to do this, since if one
aimed for breadth in the curriculum, depth would be sacrificed. One of the course lecturer pointed out that the difficulty with the vertical part of ‘T’ was knowing what to change in the specializations offered to the students.

With respect to the question of whether the industries in Singapore preferred to employ graduates with multidisciplinary knowledge or specialized skills, the engineering academics interviewed explained that there were two kinds of industries that would prefer each of these skills sets. The Head of Division interviewed revealed that small companies as well as research and development companies could not afford to employ people with diversity of skills, preferring graduates with specialized skills instead.

In small companies, they employ a smaller group of people, they cannot afford to have a diversity of skills, if they want the person, they want a certain skill, particularly if that company is very specialized. They want to get a person who knows what to do, some of our students may not know how to do that. (HD)

This academic pointed out that small companies looked for specific and specialized skills and this was a problem which a broader curriculum had to address. Other academics, however, pointed out that much of students’ learning occurred on the job. The issue was, therefore, the extent to which the University should strive to come up with a perfect match of its program with the skills demanded by the industries. After all, there is a multitude of different skills students need for the great diversity of jobs they enter into. Despite this, the academics were concerned with the industries’ reception of this curriculum change.

One of the Vice-deans interviewed elaborated:

So while we will like to broaden, we are also very much concerned about how this will impact on the readiness of the industries. Over the years, the industries have come to receive our graduates, the fact that our graduates are very well prepared. When they graduate, they are already operational, you don’t have to send for another six months to one year training, they can work straight away. (VC1)

This comment showed that the Vice-dean was concerned that students were well equipped for the workforce. The academics who were course coordinators felt that the
industries preferred to employ graduates who could perform the job immediately with very little further training. Yet other course coordinators felt that the training of students in multidisciplinary skills was good for companies as they were now more familiar with more concepts and could work better with others in the other disciplines. There appeared to be a mix of views about what industries wanted. All but one of the academics felt that with this broad based training, students could be better at critical thinking and adapt to jobs better.

Two diverse views are shown in these comments:

I think I agree in principle the change because it's to broaden the subjects the students will be learning, broaden their skills, their perspective, so that they are more aware, not so narrow in their focus, more aware of other areas of engineering. Next time will be able to work better with people in other disciplines, because when they go out to work, they will definitely need to work together with people with different disciplines. (AT6)

A different viewpoint was presented by another academic:

Basically we are training what we call generals, people who must know very wide areas, but I don't think everyone should be generals, we need the sharp shooters who only learn how to shoot, who know how to do circuits and nothing else. So we need such people who are more specialized and not so general. Because if everybody is very general then at the end you don't have what you call cutting-edge. (AT7)

From these two comments, it could be seen that there were advantages and disadvantages linked to this move to broaden the curriculum. On the one hand, it helped students work with people of other disciplines but there was also a need to train a group of students in specialized skills who could be involved in what this academic called the 'cutting-edge' of technology. On the other hand, engineers needed multidisciplinary knowledge to work with professionals of other fields. Therefore, the task in setting the curriculum had to do with reconciling these two diverging aims and fulfilling the many demands in the industries.

The academics expressed a diversity of views about the kinds of graduates industries were looking for due to a few reasons. Firstly, they were referring to different sectors of the economy. Secondly, since the interviewees were of different ages, their
reference point could be of a different era of Singapore's economic development or being specialists themselves, they preferred students to specialize.

It seems academics felt disconcerted about this curriculum change because they were uncertain how it would be received by the industries and there was no way of ascertaining industries’ responses. They also felt that lesser specialization in the engineering curriculum was a loss. The University should make some attempt to address these academics’ two concerns. Failure to do so can result in students having the same concerns as shown in the next section. It can also affect the success of the change implementation. The next section therefore goes on to describe what took place in the process of change implementation.

5.7 Curriculum Diffusion

At the end of the dissemination process of the curriculum change was academics’ adoption of it, as shown in Figure 3 in Chapter Three. This was an important area in the process and it affected students’ learning directly, which in the eyes of the policy-makers, is the outcome of the educational change. This study sought to find out what actually happened in the implementation of the curriculum change, also known as curriculum diffusion (Kelly, 1980). The interviews therefore invited the interviewees to comment on the nature of change to the curriculum and the subjects they were teaching.

In broadening the curriculum, subjects were added to the curriculum which was made possible by reducing existing subjects in the second year by one academic unit or AU. More subjects were therefore added without an overall change to the total number of subjects students have to take in their second year of study. As elaborated by one Vice-dean:
What we did was that each subject which was formerly 4 AU, we have cut it to 3 AU, so as I said, when
you cut it to 3, you’re trimming the syllabus by one-third, so the advanced topics will be taken out but we
still have one subject. But because now we have reduced the AU by one AU, we are now able to have
one or two more subjects in each semester. In fact, having small number of units, smaller number of
topics, but the number of subjects we have before are still there. (VC1)

The concern expressed here was to retain the subjects that were previously taught. This was accomplished by reducing the academic units (AUs) of each subject (Chapter Two, p. 21). This, however, led to students doing more subjects than before. Their study workload was obviously increased. Another issue was also that, with the reduction of credit units, academics had to decrease their courses’ content accordingly. The question of how prepared they were to do this and what to leave out was not simple as they had been used to teaching their existing syllabi. They also had deep convictions that students needed to know about their courses.

All the interviewees at the management level, namely the Vice-deans, Program Director and Curriculum Committee member, revealed that the decision to change to a two-year common engineering program was made at the University’s top level and handed down to them. The change was decided at the University Academic Board level and communicated to the School Curriculum Committee, the Heads of Division level and finally, to the academics. As one Vice-dean explained:

Even before then, a committee, a taskforce where I was involved was informed to look into it. But we were not told whether we should or we should not do it, our task was to implement. (VC1)

This comment shows that the decision to make the curriculum change had already been made and the academics were expected to implement it. The way they coped with this was to set up a committee to devote time to implement the change. In other words, this was a top-down decision and the change is disseminated from committees at the top to committees lower down.
All the academics interviewed confessed that their tasks were mainly to reduce the contact hours in their courses, from 39 to 26 hours, and this entailed a trimming of the syllabus. The decision, therefore, had to do with what topics to exclude, and in terms of their delivery, nothing had changed. The academics were fully aware that when students graduate, their work might have nothing to do with engineering and the courses they studied. One of the reasons given by the Vice-dean not to have students specialize too much in the undergraduate program was due to this. If students were keen to pursue a certain area of specialization they could continue with postgraduate studies and this curriculum change would then encourage students to study further.

A problem that arose from this change was that there were too many topics to cover in the courses. This resulted in students not getting sufficient depth in subjects taught as well as the adequate prerequisites to go into the third year which was specialized. In addition, too many subjects were taught within a short time. An academic reacted towards this and argued that students should be taught 'principles rather than procedures' as well as 'fundamentals'. In his words:

The basic types of things they need to learn are basic physics, mathematics, chemistry, then in the next three years they have to learn technology which as you know changes a lot. But even in technology there are some basic things, like, you know, whatever you throw up must come down, the currents do not accumulate so all the currents are at a particular point add up to zero. So, basic principles like that which we should give them. (AT7)

Teaching students the basics was one way of coping with the current situation of changing expectations of industries and uncertainty of career choice for students. One of the decisions involved in an engineering curriculum is the balance between teaching of fundamentals and multidisciplinary skills (Ditcher, 2001). This academic's argument for teaching fundamentals was that ultimately these would not change and the onus was on
students to apply the knowledge. It is important therefore to examine students' learning resulting from this curriculum change.

Whether the curriculum diffusion met the planned aims of the change could best be reflected in students' learning. Students were asked what they thought of the change in the interviews conducted. Their responses covered areas like problems encountered in learning; anxiety about effects on future career and improvements they liked to see in the present curriculum.

When asked what recommendations they would make to improve on the present curriculum, the students suggested to cut down the number of modules, not to treat the subjects as isolated modules, and to have either one year common engineering or extend the engineering program to five years. They also desired to have a choice of subjects rather than have all prescribed courses. In an interview with a second year student:

Interviewer: One last question, if you were to suggest improvements, what feedback would you give?
Student A: Cut back on some of the subjects. (S2)

This student felt there was an overload of courses for them to study. Some thought should therefore be given to students' ability to cope with the number of courses they had to take.

This student was concerned that two years of engineering specialization was inadequate and failed to see the reason for it. This indicated that the students were unaware of the rationale behind the curriculum change and the learning outcomes expected of them. Secondly, it also showed that there were students who preferred more specialization. The number of subjects that the students took appeared to be an overload leading to stress in learning. They also felt that the diversity in subject areas was too great, resulting in them not understanding the reason for taking those subjects.

Students had both positive and negative perception of the likely effects of this change in curriculum on their future career. On the positive side, two of the Year 1
students felt that the broad-based curriculum helped them to see the relationship of subjects. In addition, one Year 1 and one Year 2 students felt that what they learned in the university was not as important as what was learned at work. These were the words a Year 1 student:

Because the world is changing so much, so by the time you graduate, what you learn is out-of-date. So what we learn is not very useful. I think the most important thing we learn is the method, how we learn something. (S1F1)

This student recognized that it was impossible for students to learn all of technology and that their knowledge could be obsolete by the time they graduate. He was insightful in saying that what was more important was that they learned how to learn. This ability to learn new things is a skill employers look for in graduates in interviews with managers about expectations of engineering graduates (Sng, 2001).

One Year 2 student explained that in any case half of the university’s engineering graduates did not end up working as engineers. Others felt that the curriculum helped them learn to be more flexible and provided them with a broad-based foundation (one response from a year-one student for each of these perceptions). In addition, three of the Year 2 students thought that it was to help them secure jobs in an uncertain economic climate. On the other hand, other students felt that the new curriculum resulted in a lack of confidence amongst students. Five of them also felt there was uncertainty about how the employers would receive this change. In addition, one of the Year 2 students interviewed pointed out that they did not find the subjects useful. One student was afraid that more specialization than what he received from the curriculum was needed at work. To quote a reaction a Year 2 student:

I think some subjects is wasting time. Because I think those subjects are not useful when we graduate. (S2F13)
The following were the responses from a focus group interview carried out with Year 1 students:

Student A: So you work, right, you’re actually short of knowledge. Compared to someone who only have one year common engineering. It’s quite difficult. Because you lack a bit in knowledge.

Student B: I feel similarly. I feel that the engineering course is not relevant to what we’re pursuing later in our jobs. For me it makes not a big difference, because for me, university is to build up our mental strength, it’s not what we study. Because by the time we come out, our basic knowledge is not that important. It has to depend on what are our characteristics, or what are our other factors.

Student C: Some of the subjects are not so relevant to us. For example, one of our seniors in the second year says he is studying Biology. He just prepare for the exams, and then after that he forgot all about it. That’s it. (S1F2)

The students recognized that it was the aptitude and attitude that they acquired in their engineering education that counted more than the knowledge. In other words, it was their inherent character traits that employers looked for and this was also the point made by managers in a study done by Sng (2001). One of the students confessed, however, that they simply studied for examinations and forgot what they had studied. This was also a sign that the students did not understand the purpose of having the broad-based education, nor see the applicability of non-engineering subjects like Biology to their engineering courses. More thoughts should be given to help students see the connections between the subjects.

The students still viewed courses as belonging to distinct disciplines. They expected that when they looked for jobs, employers would be hiring people with distinct specialized training. The student in this interview failed to realize that very often in jobs, engineers were required to have multi-disciplinary skills.

It seems the views were divided between whether more specialization or multi-disciplinary skills were needed at work. The students also needed to see the relevance of what they were learning for their future careers. The more optimistic students were able to see that it was the training of skills and attitude that was more important in their academic
pursuit rather than the mere accumulation of knowledge. As one Year 1 student candidly explained:

They say degree holders are just test-tube holders. It's to make us more recession proof. So we can be flexible, so we won't run out of jobs. (S1F3)

It was interesting that this student used the metaphor of ‘test-tube holders’ to describe themselves. ‘Test-tube holders’ could mean that they were kept in the University for as long as there was a recession since it was hard to get jobs. It could also suggest ‘insularity’ and could imply either that students only had narrow knowledge of each field of engineering or that they lacked knowledge of the outside world. This student also sensed that the move to broad based education was to help them be flexible so that they can get jobs, especially in times of recession. A recommendation for undergraduate engineering training was that it should be broad so as to provide not only a strong basis for an engineering career, but also careers in other professions (Straits Knowledge, Feb 2002). A study had been conducted by the present researcher showed that managers of companies felt engineering graduates needed a diverse range of skills to function in their jobs. The study revealed that employers sought qualities such as self-interest, interest in the job, ownership of job assignments and initiative to learn on the job (Sng, 2001).

These interviews with the students showed that the goals of the curriculum change have not been effectively communicated to the students. Also, they failed to see a change in teaching approach. It seems that an explanation should be offered to them regarding the reason to broaden the curriculum versus going deeper into specialized subjects. The areas that the academics disagreed on were the exact spheres of confusion for the students, namely, the skills expected of the industries, too many courses to study and the broad versus specialization debate. Where academics disagreed, the students seemed likewise to differ on the same matters. It could be seen, therefore, that though the goals of broadening
the curriculum change were clearly set by the policy-makers, the implementation of the curriculum change was not a simple process. Ultimately, the question was whether the students learn what was expected of them. The next question in the interview instrument is therefore what are the effects of the curriculum change on the students?

5.8 Academics' Adoption of the Curriculum Change

This section presents the academics' and students' views on the problems the latter face in the broad curriculum. The effects on their learning and the match between their expectations of the curriculum and what they end up studying are presented here. In addition, students' recommendations on improvements on this curriculum were elicited.

One of the problems is that the number of students academics have to teach has increased twofold, from 900 to 1800 students. Consequently, they also ended up teaching students with diverse abilities. One academic commented:

Firstly, we have a problem of having a very big students cohort, a wide spectrum of people coming in. So it's difficult to teach very good students with very poor students, difficult for you to pitch your lessons. So, on top of this, it's even broader now. So, instead of EEE having 900 students, now the same subject is being taken by 1800 students, so you have to increase teaching hours. (AT 5)

This academic raised a serious pedagogical problem here. The broadening of the curriculum had doubled the cohort of students for their courses. As a result, the academics had to teach large groups of students with widely diverse abilities. This posed a problem of knowing the target teaching level that ensure that all the students learn effectively. This problem was obviously not anticipated at the time of planning of the curriculum change as well as individual syllabus of the courses.

In terms of teaching approach all the interviewers confided that essentially it had not changed. What had changed was the reduction in contact hours which necessitated that they trimmed the course contents. The decision was in what to cut down.
teaching, one course coordinator and two course lecturers voiced out the problem of adapting the teaching to the reduction of hours. There were the teething problems of teaching staff forgetting about this change and tried to cram teaching contents into fewer hours of lessons. One of the coordinators felt that each academic had his/her individual teaching style. He expressed that though the curriculum was now common, the teaching should be devolved, while students sit for common examinations.

In general, the students interviewed did not have a deep impression of what their academics felt about the change. Two of the Year 1 students felt that their academics’ responses were a mix of passivity, a focus on their own subject areas and examinations, rather than show relationship between different courses or disciplines. This is shown in an extract of a focus group discussion:

Interviewer: Can you remember anything, the academics, tutors or Dean, told you anything about the two years common engineering?
Student A: They just talk about their School’s specialization. They didn’t say anything else.
Interviewer: How about their attitude towards the two years common engineering.
Student B: They just teach per normal. They just said this subject, you want to learn more about it, then you take EEE. They just focus on their tutorials and teaching.
Interviewer: Do you see the subjects that you do, any link, for example, between EEE, MPE and SME?
Student B: We just treat the subjects as isolated subjects. They already specify for us, this one is for this School, that one, will be for that School. (S1F4)

The students’ comments showed that in practice the academics’ teaching had not changed. The academics still focused their attention on teaching their individual subjects, understandably, as they were specialists in their own areas. Subsequently, students were still unable to see the connections between their courses. According to student B’s last comment, students still viewed the courses as belonging to the different engineering Schools. In the words of one Year 1 student:

What the lecturer explained was that it was to make us more well-versed, more, more well-rounded, so that when we go out to out we will have these little bits of knowledge and information, may help you to set up a platform for your work. (S1F5)
There seemed to be a lack of clarity of what or how much of specialized and multidisciplinary skills jobs required. Students held the assumption that having specialized skills was crucial and gave them credibility as graduates. Also, since the academics’ teaching approaches had not changed, they also failed to see that they were required to acquire a different set of skills from those in the former curriculum.

It appears that what will help students in terms of gaining an understanding of learning goals of the change is for academics to explain these goals as well as relations between subjects. Their teaching approaches should also demonstrate a training of these skills. When students fail to see the relations between subjects, they fail to understand why they are required to take them in the first place and how these subjects benefit them. In addition, they felt that if certain learning outcomes and skills were desired of them, the key issue had to do with not just changing the curriculum structure but also the teaching approaches and methodology.

In the interviews, the academic staff were asked about their perception of this change on the students, both in terms of their learning and future careers. Both the Vice-deans interviewed felt that this change to a two-year common engineering program had some effects on the students’ learning. One of them highlighted the fact that students needed to change their expectations and be flexible. Another Vice-dean pointed out that students might lack interest in engineering courses outside their chosen field. He used the metaphor ‘medicine’ to explain his view. The second Vice-dean said:

But I think that from the ground, from the students’ point of view, I don’t think it’s a popular choice because students obviously find that they have very specific interests. They’re now asked in their second year, instead of studying electrical engineering, which is their interests, they have to worry about thermodynamics, which to them is a nuisance ‘So it’s a bit of different medicine we’re giving them. (VD 2)

This Vice-dean pointed to an important factor in learning, namely, students’ interests and expectations. If students had expectations to specialize in their university
education, they would consider unrelated courses to be ‘getting into the way’ of their pursuit. It was also interesting that he used the metaphor ‘medicine’ as if to say the students did not have much of a choice, that courses were prescribed to them much as medicine was prescribed to a patient. This element of choice could also affect students’ motivation in learning.

According to the first Vice-dean interviewed:

So the idea is to have two years of common engineering that is to broaden the syllabus. In some ways, it may affect the way they learn. But it is very hard to figure out what is it we want them to learn. In terms of skills set, the students have come into the university with a kind of expectation. The way they respond, it’s really hard to say. It comes down to how prepared they are to be flexible, in the way they are to adapt to these changes. In terms of the mode of learning, I don’t think it’s going to change that much. (VD 1)

The Vice-dean felt that students’ expectations affected the way they learned. He was doubtful that the structural changes to the curriculum alone would make any change to students’ learning style. He pointed out that both students’ expectations and a flexible attitude were important in students.

In addition, the Vice-deans felt that students should have more flexibility to choose subjects and decide how they want to broaden their field. At the moment, 80% to 90% of subjects were core, and the suggestion was to retain a small number of core subjects, while allowing students to choose between other subjects:

I’ll like to give the students more flexibility. That is, we broaden but we let the students say how they want to broaden themselves, rather than say this is the same, almost 80 – 90%, everybody has to go this way, because some people want to go a different way. As an engineer, they have a choice. (VD 1)

The students interviewed also wanted the freedom to choose the courses to study. One student asserted that a large majority of students had to follow one path, when ironically, they could exercise freedom of choice with the kinds of jobs to take up when they graduate. The very fact that no freedom of choice was given to the students was incongruous with reality.
The course coordinators interviewed also stressed the importance of students having the right attitude, saying that a change in curriculum alone would not change students’ mentality. Two of the course coordinators emphasized that students should not view the subjects as required courses to be cleared but should continue to learn about these areas throughout their lifetime. The course coordinators recognized the advantages of this broader curriculum as firstly, allowing more time for students to decide on their specialization and secondly, giving students knowledge in more areas of engineering, thereby, increasing their self-confidence as well as adapting to a ‘trend in engineering where projects cut across disciplines’. Two of the academics interviewed also revealed that now students had to be more independent learners.

This ability to learn new things was also stressed by another academic:

To be honest, with electrical engineering, especially, in my area, once students go into company, in my area, first thing the company does is, they make the students unlearn whatever we have taught them, and they put everything altogether. So, it doesn’t matter. What they want is, they take students who have good academic background because there is obviously a correlation. Students who have done well in exams will obviously do well in unlearning and relearning. So it doesn’t matter altogether, whether it is a broad based curriculum, it doesn’t matter, it will be changed all over again. (CO 1)

This course coordinator emphasized that employers were looking at graduates’ ability to learn and not just their knowledge. Employers look for engineering graduates who are willing to learn on the job and adept at learning new skills (Sng, 2001). In this case, it makes sense to train students in flexibility, and ability to acquire new skills and knowledge quickly. For this reason too, this coordinator argued that it did not matter whether the curriculum was broad-based or not as the graduates had to acquire a new set of knowledge once they entered the workplace. He also asserted that ‘it will be changed all over again’. ‘It’ in this instance could refer to technology which is of course constantly changing and developing and therefore the knowledge about technology that engineers need to possess will change. ‘It’ can also refer to the fact that what the students study in the
university will be a different knowledge from what they are required to have in their jobs. One coordinator explained this:

They will have another kind of motivation, which is the power to combine different knowledges to invent something new. 'They feel that if they learn more, then they can combine different knowledges to arrive at some new ideas. We still have a lot to do to change their mentality. I mean of teaching, we need to emphasize much more on their analytical skills. You need to show that analytical skills, basically, you need to show the students that analytical skills are important. So basically what you learn, and what you think, will you learn this subject, actually will be applicable to another subject. (CO 2)

It was hoped that by having students acquire knowledge from each field of engineering, they would be prompted to combine these different areas of knowledge and come up with innovative ideas and inventions. This academic recognized, however, that exposing students to knowledge alone was inadequate to accomplish this. The students should develop analytical skill as well. It may not be possible to teach analytical skills by a didactic teaching approach, especially through lectures. It may be necessary to adopt teaching methodology in tutorials and also appropriate assessment that will inculcate analytical skills in students. In addition, the academic raised the importance of having students realize the interconnections and applicability between different disciplines. In other words, it was hoped that this broad-based approach would help students in applying their knowledge of different courses in constructing projects and inventions.

One of the academics argued that students should not be forced to do a fixed combination of courses but be given flexibility to choose subjects. Another coordinator recommended that they be allowed to decide whether to start specialization in Year 1 or 2 since certain students in Year 2 were weak and would benefit in the long run to go through the first year program.

Five of the year 2 students interviewed claimed that their courses in the two-year common engineering program were interesting. One student felt that it was good to obtain knowledge of subjects which was going to be useful in his future work. Three of the Year
2 students interviewed felt that it was useful to gain knowledge of other fields of engineering, while another four students felt that the curriculum broadened their knowledge. Only one Year 2 student interviewed said the curriculum helped him see the relationship between courses. One student held the optimistic view that the broad curriculum helped to train him in thinking skills, and another student stated the benefit as that of cultivating the ‘T’ student. These were the comments made by a Year 2 student:

I think that’s more the idea that was set. It’s to make engineering students more ‘T’ students. I think the rationale is good. The rationale is that in the current economy, as an electrical engineer, we cannot just know electrical stuff, we need to be more widely versed in other forms of engineering. (S2F14)

This student seemed to be aware of a goal of the curriculum change, namely, to train students who possessed both multi-disciplinary and specialized knowledge. The ‘T’ student was an ideal that the changed curriculum hoped to achieve but the focus interviews revealed that the students encountered some learning problems in the process.

The students interviewed described their difficulties with learning resulting from the change to the two-year common engineering program. Six of the Year 2 students and one of the Year 1 student felt that there was not enough specialization. Twelve of Year 2 and eight of the Year 1 students felt that they were learning irrelevant subjects. In addition, four of Year 2 students confided that they forgot what they had learned due to the large number of subjects they were taking, and the same number of students also felt they had to make a choice about their specialization too early, namely, at the end of first year of the common engineering program. Two of the Year 2 students, and one of the Year 1 students, felt that they were not given a choice of subjects, since all the subjects were prescribed. Three of the Year 2 students and one of the Year 1 students felt that the two-year common engineering program added to their stress due to the large number of courses they had to take. Lastly, four of the Year 2 students and one of the Year 1 students felt that the two
years was too long for a common engineering program. A Year 2 student described his learning difficulty as:

By the reduction of one year in the specialized course, probably, you may not be competent enough, you know. In the modern society, competition is very keen. Will the students in NTU be able to meet up with the standard. This is the main concern of most of the students. (S2F15)

In addition, one Year 1 student commented:

The subjects are very wide but not very deep. For third and fourth years, you have to choose subjects which are very deep. (S1F16)

This student was concerned that they were not getting enough specialization in electrical and electronics courses in order to secure jobs in a competitive job market. He felt he was losing out to students who had obtained more specialization in their training. This shows that students expected that in their university education, they would be provided with specialized knowledge which would in turn prepare them to handle jobs after they graduate. For this reason, this student felt he would have to learn many things related to electrical and electronics engineering himself as two years of his studies were spent on a broad-based education. This shows that students were somewhat lacking in career guidance, in terms of the changing trends of employment and skills required as well as how their university education was preparing them to face these changes.

It seems the students failed to understand the purpose of taking so many and varied range of subjects. They were unaware of the kind of learning expected of them in the curriculum, or if they do, did not understand how the existing approach could produce the desired learning outcomes.

The effects of this change in curriculum on the students can be summarized in a few areas. Firstly, a question exists as to whether the contents covered in the curriculum are within the range that students could cope. Secondly, students' attitude to learning governed their response to this broad based curriculum. Thirdly, they were uncertain of the
skills needed in future jobs, and lastly, they felt they should be free to choose their combinations of subjects. The academics confessed that students could not choose their subjects when they should be able to do so. Another recommendation was to teach them the basic principles and fundamentals. In other words, the teaching that occurs in the classroom is also important, since academics can choose to expose them to happenings in the world, and motivate them to learn further. The feedback from students is useful in identifying the problems in the curriculum diffusion. The problems faced by students are also indicative that the change had not been effectively executed by the academics.

5.9 Conclusion

The interviews with the academics and students therefore revealed some significant insights about the change implementation process, the effectiveness of communication about the change and the effects on students and academics.

These interviews with the academic staff revealed that there were divergent views amongst them on the source of the change, and it was vague to them who these policy makers were. A Vice-dean interviewed revealed however that the decision was reached within the University itself. The goals of the change were identified as preparing students for a fast-changing, knowledge-based and high-tech economy where they need multidisciplinary and flexible skills to adapt to jobs. Regarding the change process, the academics could not identify leaders of the change. They pointed out that the change was discussed amongst the committees at various levels and then the team of academics teaching specific courses. They could not see any leader or leaders championing the implementation of the change. This shows that the collegiality did take place in the implementation process though the initiative to make the change took place at the higher
level of policy-makers. With regards to the teamwork amongst the academics, it was rated to be good by the interviewees. This shows that, in general, there is a support for one another in the team.

The interviews revealed important findings on the motivation, direction and goals of the change. With regards to motivation, the academics and students had some vague impressions that it originated from the government, stemming from global economic change to a knowledge-based economy. The academics did not receive clear directions for the change. They felt that the curriculum change was implemented in a hurried manner and more thought should be devoted to the learning outcomes. Knowledge of the motivation and direction of the curriculum change is crucial considering the scale of the desired outcomes, that is, to produce relevant skills amongst graduates to cope with the knowledge-based economy. In addition, the academics felt there was no time for them to formulate clear goals for the change. Goals were important as a guide for the academics to know how to implement the change in the courses they were teaching, as well as evaluate the outcomes. Finally, with regards to what recommendations to the implementation process, the interviewees responded that more time should be given for them to discuss the change, more flexibility given in terms of students' choice of courses and more communication at all levels for those responsible for making the change and are affected by it.

Communication was identified by all academics and students as an area that needed improvement. It seems they would like more channels of communication with the higher levels, namely, those involved in the planning of the curriculum change. The academics associated such communication with regard for their professionalism. They felt that more discussions of the curriculum change would yield better results in terms of ideas of
teaching approaches that could produce the desired learning in students. The positive point was that teamwork was rated as good by the academics though they wished there were more opportunities of communication with people at the higher levels of the hierarchy.

Learning in students and their expectations were two major areas in terms of effects of the curriculum change on students. In terms of effects on students, it was emphasized that what was important was their attitude towards the subjects. Learning and teaching should encourage them to acquire critical thinking skills and see a relation across the various disciplines. In addition, effective communication was crucial in setting up pertinent expectations in the students. Interviews with the students revealed that they were unclear as to how much of in-depth specialization in engineering and broad-based knowledge was expected of them in the workforce. Such knowledge was important for students in helping them see the relevance of what they were learning and know how to focus their learning. One student pointed out that if the aim of the curriculum change was to produce broad-based learning, flexibility should be given to them to choose subjects. In terms of learning therefore the students resorted to rote learning which was not the learning approach intended.

This chapter has presented the data collected from the interviews, focus group discussions and documentary analysis. In the next chapter, a triangulation of data gathered from interviews with the academics, focus group discussions with the students and documentary analysis will be carried out. The issues raised in these three sets of data and their implications will also be discussed in the context of educational change in Singapore.
CHAPTER SIX
ANALYSIS OF ACADEMICS' RESPONSES TO THE CURRICULUM CHANGE:
DISCUSSION OF DATA

6.1 Introduction

This chapter discusses the implications of the data in relation to two areas. Firstly, it examines the external dimension of educational change, in terms of the government policy, and within the organization, consisting of the university leadership as well as management. Secondly, this chapter relates the significance of the findings to the insights drawn from the literature review and other studies conducted by academics in the present school.

The conceptual framework in this study, as shown in Figure 3 in Chapter Three (p. 46), involves the effects of contextual and organizational factors on academics' responses to the curriculum change and the subsequent changes they made to their teaching. Therefore, this chapter discusses the data gathered from interviews, documents and focus group discussions on these contextual and organizational factors. This chapter also examines the effects on the academics, their responses and adoption of the curriculum change. The conceptual framework of this study is developed from Blenkin's et. al. (1992), Etzioni and Lehman's (1980), Taba's (1962) and Reid's (1978) theories of change as shown in Figure 3 in Chapter Three (p. 46). Blenkin's et. al. (1992) perspective of change states that change is an inevitable and essential part of adaptation to an ever-changing environment. This chapter therefore discusses the effectiveness of implementation of the curriculum change in meeting the needs of a changing economy. Etzioni and Lehman (1980), Taba (1962) and Reid (1978) claimed that organizational factors affect members'
responses to change. This leads to an examination of how effective these factors are in communicating the purpose of the change as well as involving them in the curriculum change. This chapter also weighs the effectiveness of the curriculum change in practice and looks at areas of improvement in the implementation of the curriculum change.

This chapter begins by discussing academics’ knowledge of the motivation as well as purpose and goals of the curriculum change. It goes on to examine what the academics revealed about their involvement in the change implementation. The nature of curriculum diffusion is also explored followed by the academics’ adoption of the curriculum change.

6.2 Organizational Structures and Effects on Academics

This section examines whether communication of the purposes of the change at the national level to the academics, had been effective (Figure 3 in Chapter Three). It compares official statements about the motivation for the curriculum change with the academics’ knowledge of this. Through this comparison, an assessment of the communication effectiveness regarding purposes and goals of the change can then be made. The dissemination of curriculum change from the top level such as the governmental ministries, to a large and complex organization like the university, is a complicated process. Communication is therefore difficult.

In this study, data collected from both documents and interviews exhibit a convergent model of higher education, as explained by Weert (2000). In this model, the role of higher education is to prepare graduates with skills needed by the workforce. This means that the university has to be flexible and responsive to change. The organizational structures of a university govern how adaptive it is to external changes. The university is a complex organization and possesses a mix of bureaucratic as well as collegial models (Scott, 1984).
According to Warner and Palfreyman (1996), a bureaucratic structure leads to formalized decisions and procedural power as well as a control of information flow. Collegiality, on the other hand, encourages team participation and feedback. Farnham (1999) explained that change-oriented universities combine managerial with collegial decision-making. This study examines the communication of decisions about curriculum change to those below, namely, the academics and students. This section discusses the data collected on the way decisions are reached about the curriculum change and the communication of this change to the academics and students.

In this study, it could be seen that the dissemination of the change took place from committees at the top hierarchy to those below, namely those teaching the courses. The bureaucratic nature of the university brought about such a mode of dissemination. What is needed, however, is more effective feedback coming from those below, namely the academics and students, to those at higher levels. In other words, according to Schon's (1971) model (Chapter Three, p. 37), the focus of the change dissemination had been from the center to the periphery points, but not enough communication took place from the periphery to the center. In addition, by the time the directive to change reached the periphery, the purpose and goals of the change had not been effectively communicated. This resulted in a lack of knowledge at the academics and students levels, and a discrepancy between the adoptive and adaptive aims (Kelly, 1982) of the change. There was collegiality taking place within committees involved in planning the implementation of the change. However, the level of academics’ involvement in these committees was limited to structural changes in the curriculum. The purposes of the change had not been effectively communicated to them for them to discuss deeper issues of teaching approaches and assessment. In addition, there was no change in the beliefs and attitudes of the
academics to a degree that would prompt them to change teaching practices. Returning to the conceptual framework represented in Figure 3 in Chapter Three (p. 46), it can be seen that effective communication of the curriculum change is needed not just from the top to the bottom levels but also from bottom up. The findings from the interviews show that bottom up communication is needed so that the policy-makers can be aware of the effectiveness and problems related to implementation of the curriculum change, as well as adjustments needed in the process. In addition, the interaction and collaboration amongst the academics are also important in helping them implement the change. There is, therefore, a need to examine the academics' awareness of the motivation of the change.

The assumption in the conceptual framework (Figure 3 in Chapter Three) is that the context of the curriculum change, such as the political and economic factors, influences academics' responses towards it. The reasons for a broadening of the University's curriculum are found in the documents, *The Strategic Economic Plan, Towards a Developed Nation* (1991) and *Committee on Singapore's Competitiveness* (1998), as well as two speeches by the ministers in Singapore, *Speech by Minister for Education, RADM Teo Chee Hean at the Budget Debate on 20 Mar 1998*, and *Speech by Dr Tony Tan, Deputy Prime Minister and Minister for Defence, 18 Dec, 2000*. These were to inculcate in students the relevant skills which are in demand in the industries both in the present and for the future. According to these official documents, it is believed that a broad-based curriculum will result in the learning outcomes of greater flexibility and innovativeness. It is not stated in these documents, though, whether educational research has found this to be true. There is a high degree of consistency in the role of a university education in terms of economic development in Singapore. These documents span across a time frame of ten years, from 1991 to 2000, yet the claims on the role of the university and the motivation to
broaden the curriculum have been consistent. It is also very clear that these are the official statements although the authors of these documents are not given. Instead, the sources of such information seem to be either the Ministry of Trade and Industry or the ministers. In other words, the impression created is that this is the official voice on the purpose of a university education. It may seem strange that the Ministry of Trade and Industry is publishing statements about the purpose of education, but in the case of Singapore, it is this Ministry of Labour that determines the economic needs and therefore the direction for the education system (Chapter Two, p. 14). Logically, the Ministry of Education is related to Ministry of Trade and Industry. It is evident therefore that economic needs and drives take precedence when it comes to issues related to education.

The official statements about the motivation for the curriculum change concur with the views presented by the academics at the School's management. These academics, namely, the Vice-deans and the member of the Curriculum Committee, identified the motivation of this curricular change as preparing students to adapt to a fast-changing economy where multidisciplinary and flexible skills are needed at work.

The motivation for broadening the curriculum originated from a need to prepare students for both the changing nature of work itself, and coping with change in general. External changes require that graduates have a rich resource of knowledge and skills relating to different disciplines, as well as the ability to relate to people of different disciplines. It was also hoped that by exposing students to knowledge of different fields, that they were able to combine this knowledge and learn to be innovative. The academics interviewed were quick to identify that the initiative for the change came from the government. From the documents, it is clear that the government perceives its responsibility to trace economic development trends and prepare the workforce to cope
with future changes. The way it does this is to make what it sees as relevant educational changes. There is therefore no contradiction or conflict of views between the official statements found in the documents and those presented by the academics interviewed.

The expectations of industries were identified to be the main motivation for the change. There was considerable ambivalence amongst the students and academics about how employers would receive this curriculum change. A number of the students and academics interviewed were concerned that employers might be looking for a degree of specialized knowledge in graduates. They therefore did not seem to possess enough understanding of changes in the job market and the kinds of skills that were in demand. In the study done by Sng (2001), specialized technical knowledge was not listed as the key skills for graduates to possess. Instead, the managers interviewed mentioned 'soft skills' like communication skills, flexibility, ability to learn, problem-solving skills and adaptability. The managers revealed in the interviews that technical knowledge could be acquired on the job but what helped the engineering graduates to succeed is this set of skills. A quantitative study, consisting of surveys, was conducted by an engineering lecturer (Chang, 2001) in this School. It revealed that a close consensus existed between the academic staff and students of the School on the importance of 6 transferable skills sought by employers. These were: understanding and applications; analytical skills; creativity and flexibility; communication skills; commitment to lifelong learning and sensitivity to social and industrial contexts and needs (Chang, 2001). The students rated these skills in order of priority. They placed 'creativity and flexibility' as highest in the order, followed by 'analytical skills', 'communication skills', 'commitment to lifelong learning', 'understanding and applications' and lastly, 'sensitivity to social/industrial contexts and needs' in order of importance (Chang, 2001). These were the same skills
identified by the Ministry of Trade and Industries as well as the ministers as the important skills for students. Brown et. al. (2001) also acknowledged lifelong learning as an important skill for the knowledge-based economy (Chapter Two, p. 15). This means that in the engineering curriculum, apart from training students in engineering knowledge, there should also be a focus on training of these skills. A few of the students interviewed in the present study realized that the aim of the broad-based curriculum was to train them to be flexible but a few other students voiced their apprehensions of the change. This shows that broadening the curriculum change must involve considerations more than replacing certain subjects with others. Over and above this, there was a need to discuss the rationale of the curriculum change with the academics and students. This ambivalence about industries' receptivity of the change inevitably led to students being apprehensive about their future employability.

Therefore, there is a consensus of views that educational change should meet national economic needs and this is one of the main motivations of educational change in Singapore (Khoon, 1991). This also means that one of the main challenges in implementing such adoptive change (Bolam, 1975 and Kelly, 1982) lies in alignment of values and objectives of the policy-makers with the educational institution (Morrison, 1998). This proves that the context of the curriculum change influences academics' responses. In addition, organizational factors also affected their responses, as shown in Figure 3. The academics and students interviewed felt that the communication of the purpose, aim and expected outcomes of the educational change from the top level to the ground level needed improvement. This also means that there should be an ownership at the institutional level, of the purposes and method of implementation of the change (Rowley et. al., 1997). The findings of this study show therefore that effective communication is needed at every stage
of dissemination process. The sections below examine these issues in greater detail and the next section discusses the views of these documents and academics on the need to train students to face the new knowledge-based economy.

6.2.1 Academics' Knowledge of the Purpose and Goals of the Change

The model represented by Figure 3 assumes that academics respond to the change according to their knowledge about it. There is a need for university education to prepare students for a shift in the global economy, from a production-based economy to an economy that is dependent on generating knowledge. As seen in the writings of Brown et al. (2001) and Mok and Tan (2004), this new economy demands a different set of skills in the workforce (Chapter Two, p. 15). The aim of this curriculum change was to produce these skills in students. This section discusses the academics' view of the knowledge-based economy and how the curriculum change in practice succeeds in inculcating these skills in the students. Other educational considerations in achieving these aims are also discussed.

There is a consistency of argument in all the ministerial speeches in terms Singapore's competition in the knowledge-based economy, and how education has to adjust to such a change by equipping students with a wide range of skills. In both the ministerial speeches and the literature on engineering education that is published outside of Singapore (Beder, 1999; Ditcher, 2001; Fournier-Bonilla, 2001), broad-based education is seen as the key to both engineering careers and other careers in the face of uncertainty. There is inadvertent pressure coming from the government for the University to ensure that students are trained in these skills. Such external circumstances explain the rationale for the change in the engineering curriculum in the university. Apart from the curriculum, however, the ministers made no mention of other educational factors that are just as crucial
in producing such learning outcomes. These factors include teaching approaches as well as assessment methods that should be equally flexible to motivate students to acquire flexible skills. There is therefore a need to examine more deeply the teaching methods and mode of learning in this area. It is probably not the domain of politicians to go into such specifics and this is clearly the areas where the academics' inputs, experience and views play a crucial role because of firstly, their professionalism, secondly, their specialized knowledge in their subject areas, and lastly, their knowledge of students as well as experience in teaching. The academics interviewed clearly indicated a desire to be more involved in discussions of implementation of the curriculum change. The students, likewise, had their opinions and channels of communication were needed for them to discuss these with the academics. Rowley et al. (1997) wrote that educational change, if imposed from the top, will be unsuccessful and result in many problems unless it is participatory in nature and academics in particular are key personnel in this situation (Chapter Three, p. 23). In the conceptual framework shown in Figure 3 in Chapter Three, it is assumed that academics' participation in the change process influences their responses towards it. The findings from the interviews show that their involvement in the curriculum change leads to their belief in and ownership of the change. Therefore, there should be discussion between policy-makers and academics regarding such educational changes and it is also important for academics to be aware of external economic needs. Consequently, the question is what they understand about the knowledge-based economy and what they feel to be the kind of curriculum changes needed to prepare students for this new economy.

An academic interviewed explained that it was knowledge, rather than capital that drove economic growth in the knowledge-based economy. He felt that life-long learning was needed. This is affirmed by Aronowitz and DiFazio (1999) and Brown et al. (2001),
who claimed that, at present, knowledge, rather than traditional skill, is the chief productive power. Knowledge becomes intertwined with technology, and labour-intensive work becomes replaced by capital and technology-intensive work (Aronowitz and DiFazio, 1999). In addition, knowledge is no longer just tied to specific production processes but has become 'a free floating commodity' to the degree that it can be transformed into information with no specific production objective (Aronowitz and DiFazio, 1999, Chapter Four, p. 80). Aronowitz and DiFazio (1999) claimed this is the result of the move from industry-specific labour to computer-mediated work. This spells the need for Singapore to move in the same direction of generating knowledge to keep pace with such a transformation in the global economy. Consequently, this means that Singapore has to engage in this generation of knowledge to compete in the global developments in technology. As one of the academics and students interviewed explained, students should be trained and motivated in research and creating new knowledge.

However, for the students' knowledge to be transferred into application, more needs to be done in terms of getting them to apply the knowledge of these different fields. As a few academics and students pointed out, the objectives of a broad-based engineering education could be met by not just a structural change in the curriculum, but a change in the teaching and learning approaches. Busher (1990), Nisbet (1975) and Huberman and Miles (1984) claimed that educational change happens through a process of interaction between people. It is therefore important to examine the beliefs and attitudes of the students towards broad-based education as well as how they interact in making the change. This means that effective communication from top down as well as horizontally amongst people in the organization is important, as this fosters a smooth working relationship amongst participants in implementing the change. It is the support from one another that
helps academics cope with the pressure of educational changes and to implement them effectively.

However, the fact that more communication about the purpose and implementation of this change is needed is evidenced in the problems raised by both academics and students interviewed. One of the academics was concerned that the students lacked focus, and the students themselves confided that they failed to see the relationship between their courses. Another academic was faced with teaching a large group of students with diverse abilities, many of whom lack the relevant background for his course. These problems showed that implementation of the curriculum change should go beyond taking a few topics out of a course. Such a superficial change had obviously not resulted in the students seeing a relationship between their diverse courses, thereby acquiring the needed multidisciplinary skills. Morrison (1998) pointed out that effective change results from an alignment of values, practices and outcomes (Chapter Three, p. 24). The responses of the academics in the interviews indicated that such an alignment was needed and the problem stemmed from inadequate feedback from the people in the educational institution to the policy makers at the top. Therefore, the question lies in the kinds of changes needed in teaching approaches and assessment to inculcate in the students the skills demanded by industries. More attention should be paid to these two areas of the curriculum to produce the desired outcome of this change.

If this reason for the broadening of the engineering curriculum was to produce the learning outcomes of flexibility, adaptability and innovativeness, more thought should be given to teaching approaches and assessment methods. Chang's et. al. (1994) study of the engineering students in this University revealed that students' motivations and learning styles were very much shaped by the assessment methods. It was found that with a heavily
weighted final examinations system, students engaged in superficial learning with the aim of passing examinations (Chang et al., 1994). The assessment methods should therefore be reviewed and more appropriate methods, like project work, may have to be implemented to encourage students to work in teams, apply multidisciplinary knowledge and be flexible in their learning. In fact, the University has realized the value of project work in the light of helping students acquire these skills and has used these as an assessment method from the second to final years of the Bachelor program. More consideration should be given to the implementation process of the change. Firstly, there were the unforeseen problems of students not having the relevant background to take certain courses. Secondly, it was not certain if broadening the curriculum means students should take humanities and business courses apart from courses of other engineering strands. This shows that both academics and students needed to be clearer about the purpose, goals and expected outcomes of this curriculum change. In addition, the implementation process should be planned more carefully, and discussed with the academics, taking into consideration the educational issues involved. This clearly indicated that such a top-down implementation of change should be balanced with bottom-up communication and involvement.

The pressure exerted on the academics and students in the university in lieu of both local and global technological and economic changes is therefore tremendous. More thought and studies are still needed to examine how students’ learning and training can be shaped in this direction. Organizationally, improved structures such as channels of communication, can also aid academics in making this curriculum change. Such channels should allow the academics to incorporate their knowledge in both the decision-making and implementation of the educational change. The data therefore show that there is a basis for the assumption found in Figure 3 (Chapter Three, p. 46), and that organizational factors
influence the academics' responses towards the curriculum change. Responses from the academics also show that more thought should be given to teaching approaches and assessment methods that foster the skills needed in the knowledge-based economy.

Change always brings feelings of uncertainty and apprehension. Nisbet (1975) wrote that problems follow changes in curriculum and these include confusion and the loss of confidence. The students were afraid of losing out to graduates who had more specializations in engineering courses than them. In addition, they did not see the relevance of taking courses outside their intended specialization. For example, they did not understand why they were taking Biology as they did not see how this was to be useful for them in their future work. In addition, they felt that if employers wanted to employ someone to work in computer engineering, they would employ a graduate in this specialization. Therefore, they did not understand why they were taking this course. This shows that these students did not understand the rationale of the curriculum change which was to prepare them for an uncertain job market as no one had given them an adequate explanation. In addition, they failed to understand the multidisciplinary nature of an engineering job. This lack of understanding had serious repercussions on their learning. Failing to understand the purpose of taking these courses, they resorted to rote learning for the sake of passing their courses. This shows that communicating the purpose of a curriculum change to both academics and students is very important. Without this, students did not appreciate or apply what they learn. There was also a need to collect feedback about how they think the training of work-related skills should take place. Such ambivalent views on the purpose of the curriculum change are also reflected in an academic's response. Returning to Figure 3 in Chapter Three, the data show that communicating the curriculum change cannot comprise only a directive to change from the policy-maker to
the academics. The communication of the purpose, goal and direction of the change is very important. In addition, there should be an on-going two-way communication.

One of the academics interviewed felt that both 'sharp shooters' and 'generalists' were needed in the job market. By 'sharp shooters', he was referring to graduates with a large enough degree of specialization and 'generalists', those who went through the broad curriculum. He felt that 'sharp shooters' were needed for economic and technological progress. From some of the academics, it could be deduced that they felt a sense of loss in giving up the specializations in the curriculum. There is probably no 'one-size-fits-all' solution to this situation. The question is also whether prescribing a fixed combination of courses to the students is the way to prepare them for an uncertain future of work. This finding also proves the point that there must be a channel of communication available for academics to voice their views on the curriculum change and discuss its implementation.

It seems therefore that students need more career guidance and knowledge of skills required in the kinds of employment they are going to be faced with. There is also a need for academics to participate more actively about changes in the workforce and how relevant changes can be made in the curriculum. Hargreaves (2000) explained that professional collaboration can help them to harness their energy, and work their way through all kinds of requirements and demands. The next section therefore discusses the nature of change made in the curriculum and the improvements needed.

6.3 Academics' Involvement in the Process of the Curriculum Change

It is discovered in this study that organizational structures determine to a large extent academics' participation in the curriculum, as assumed in Figure 3 in Chapter Three. This in turn affects their attitudes and commitment. The academics faced unforeseen problems
as a result of the curriculum change. The problems arising from their teaching ultimately affected students' learning. There was a need for academics to participate in the entire process of the change implementation as they were the ones most affected by the problems caused by the change. They were also responsible to make the needed adjustments and ratifications. Boyatzis et al. (1991) exerted that the faculty has primary responsibility for academic curriculum and effective action, collective and cooperative faculty involvement are needed for successful innovation to occur (Chapter Three, p. 23). This section examines what the academics revealed about their involvement in the implementation of the change.

There is a clear disparity between the goals of the curriculum change and the way it is implemented. On the one hand, the aim of the curriculum change was to help the students gain a greater understanding of the course content. On the other hand, students confessed they were confused. In addition, academics complained that they had to teach large groups of students with diverse abilities and who lack relevant background, causing their teaching to be difficult. This shows that structural changes to the curriculum are inadequate to achieve the aims. In other words, just expanding the number and types of subjects that students take is inadequate in helping them see the relationships between the courses or apply knowledge from different fields of engineering. The academics themselves need to consciously show this interconnection between different courses and engineering disciplines in their teaching. This can be seen in the comments made by the students that their lecturers continued in their usual way of teaching as if their courses were isolated subjects and no attempt was made to explain the relationship with other courses.

The conceptual framework in Figure 3 assumes that academics' responses to the curriculum change have an impact on their adoption of it. The data from the interviews
show that where academics were ambivalent of the change, they resorted to a superficial implementation of the change, and did not change their teaching approach. Students' learning, likewise, did not change.

In addition, the situation of the academics teaching large groups of students with diverse abilities has to be addressed. A large student-to-academic ratio means that teaching takes place in large lectures and this will not help students gain the skills set out in the curriculum objectives. In addition, the students have diverse abilities, meaning that different teaching levels and approaches need to be used which cannot happen in large lectures. There is a need for assessment methods that can accommodate the diversity of skills in students as well as encourage students to learn such multiplicity of skills. This situation shows that academics need to be involved at a deeper level of planning of the curriculum change so that they could address the pedagogical issues involved and needed changes to teaching approaches. The academics are the ones who know the students and are involved in teaching them so their input in planning the change is invaluable. They should also be involved in planning the appropriate assessment for the students. Such feedback should therefore be given to the policy-makers and for this to happen, bottom-up channels of communication must be available.

The use of appropriate assessment method was identified as a key to helping students gain skills such as flexibility, creativity, communication skills and teamwork expected by industries. Project work was found to be a useful method of assessment as it involves students working in teams; applying multidisciplinary knowledge and skills; communicating with others and learning to be creative. This was found to be the case in all the studies conducted on the students in the present School, namely research done by Chang et. al. (1994), Chang (2001), Sng (2001) and Karmakar (2001). There was
obviously a need to discuss the desirable mode of assessment that would encourage students to learn these skills and academics need to be more rigorously involved in such discussion.

A study similar to the present research was done by an engineering academic from the School. In this study, a questionnaire was administered, requiring the academic staff to rate the extent to which the students acquire the same set of transferable skills (Karmakar, 2001). The results showed that the academics felt that their students acquire the skills of being ‘prepared for the realities of global competitiveness’ and ‘able to apply multidisciplinary skills to problem solving’ were also poorly rated (Karmakar, 2001). In terms of assessment, Karmakar (2001) wrote that it was important, in this information age to test not just knowledge of facts but also contexts. For this, he recommended open-ended modules of assessment and greater weighting on continuous assessment (Karmakar, 2001). Karmakar’s (2001) study showed therefore that the academics themselves did not feel the courses help students acquire the skills demanded by industries. It can be seen in this study that the academics are referring not to the combination of courses but the courses themselves. Karmakar (2001) recommended change in the assessment system in helping students acquire the skills. Assessment is therefore one of the important factors in shaping the way students learn. Despite Karmakar’s (2001) findings, the academics interviewed in the present study confided that they did not make any change to their course content or teaching method. For the broad-based concept to take place, 3 out of the 23 academics interviewed felt that both the academics’ thinking and students’ learning style must change. There should be an emphasis on motivating students to be independent learners. These were pedagogical issues that the academics were aware of because they taught the students and such feedback should be given to the policy-makers.
As a result, there were a number of pedagogical issues that were not addressed in the process of implementing this curriculum change. In fact, the kinds of changes implemented were very superficial and resulted in further pedagogical problems as well as difficulties in students' learning. The use of appropriate teaching approaches to shape students' learning was not discussed adequately in the implementation process. This is especially important considering Karmakar (2001) found out that the existing courses were inadequate in helping students acquire the transferable skills (Chapter Two, p. 13). The curriculum diffusion (Kelly, 1982, Chapter Three, p. 37) needs to be improved to help students inculcate the desired skills to face their future work.

The convergent model of higher education accepts that university education should prepare students to enter the workforce (Weert, 2000, Chapter Three, p. 28). However, the academics have mixed reactions about how the change will affect the students' employability. Half of the students interviewed felt disadvantaged as they thought employers expected them to have specialized knowledge. The other half felt the change would help them prepare for an uncertain future and a multidisciplinary work context. All of these students, however, could not see how the curriculum change could instill in them skills they needed for future work. Conversely, they felt that their lecturers' methods of teaching were more important in helping them to learn these skills. The academics interviewed claimed that it was aptitude rather than knowledge gained that is useful for students since technology would have changed a lot by the time they graduated. Half of the students interviewed realized this and were aware that the curriculum change aimed at getting them acquiring this skill. If this was the case, surely the key lay in teaching the students to apply their knowledge. In other words, course content should be trimmed and more time devoted to helping them apply their knowledge. Time and discussion are needed
for pedagogical issues like teaching approaches, assessment methods and class sizes and this is where academics play an indispensable role.

Most of the academics interviewed expressed a desire for more involvement in the implementation process, particularly at decision-making level. One of the academics explained that because they were uninvolved at this level, they were uncommitted to the change. In other words, to elicit commitment from teaching staff on an educational change, they must be involved in the decision-making process. This proves that academics' involvement is important, as shown in Figure 3. This view is also reflected in Nisbet (1975) and Bottery and Wright, 2000, (Chapter Three, p. 27) who wrote that for change to be successful, it must be understood, developed and owned by the people involved. Firstly, this academic felt that the professionalism of the academics could be put to better use in decisions over educational change. He felt that they were the ones with the understanding of teaching and the students. As professionals, they should be not taken by surprise by management's decisions to make curriculum changes. This comment shows that the academics consider that as part of their professional contribution to the University, they should be involved in decisions over curriculum changes. Thus, they felt that their pedagogical knowledge plays a crucial role in such decisions. Consequently, people at the top level who are making decisions over educational change need to understand the problems faced by the teaching staff and students. In addition, the policy-makers need to listen to the teaching staff's views on pedagogical issues concerning a particular curriculum change. For this dialogue between people at the top and bottom levels of the University hierarchy to happen, more time must be given to the implementation process.

A Vice-dean interviewed pointed out that there was inadequate time for a perfect plan to emerge before they implemented the change. Another Vice-dean felt that risks are
inevitable in change and it is impossible to avoid mistakes. This urgency to change stems from a need to respond fast enough to global economic changes so that the nation can compete internationally (Chapter Two, p. 11). In education, however, desired changes and outcomes take longer time. Where the educational change is implemented in a hurry, with the teaching staff and students having an inadequate understanding about it, educational wastage can result. In the end, the desired learning outcomes are not produced and confusion results instead. More time should be devoted to communicating a curriculum change and allowing time for people to understand, commit and finally act upon it. In addition, it is important to devote time to the dissemination of the change so that people gain a clear direction of this change. Richardson (1994) wrote that deep change, in fact, requires involvement of the participants in working out both the goals and processes of change and the teaching staff are the ones responsible for resolving the conflict between means and ends in education (Richardson, 1994, Chapter Three, p. 27). It is important therefore that this process of negotiation takes place with the teaching staff so that they own the change and produce the desired learning outcomes in students. This is especially true where the planned change is intended to be long-term.

The Vice-deans interviewed explained that this move towards broadening the engineering curriculum is a long-term plan. Specific changes to the curriculum may happen along the way in response to external economic changes but the overall aim to broaden the curriculum remains the same. This shows that it is important to devote time to thinking of an overall strategy to produce the skills of flexibility, adaptability and innovativeness in students. The current attitude is that adjustments must be made in the curriculum to adapt to external economic needs. It may be more viable, however, to develop a long-term strategy to train students in the skills they will need regardless of the
kinds of jobs they enter, and to cope with changes in general. Making frequent and ad hoc changes can also result in educational wastage. Better results can be obtained from having a clear direction of change in the curriculum. Students will experience better learning outcomes and staff’s morale and contribution will be better when there is a clear direction of change. Secondly, educational change should also be initiated from within the organization, that is, amongst teaching staff and students and not simply in a top-down manner. One academic expressed that it is people in the organization who can understand the curriculum and should be the ones to make decisions regarding changes. Such a response showed that educational change is different from changes in other types of organizations (Rowley et al, 1997). The importance of devoting adequate time for the implementation of the curriculum change is a finding in this study that was not predicted in the formulation of the conceptual framework represented in Figure 3. More communication is needed for policy-makers to be aware of this problem. The next section therefore goes on to discuss this issue.

6.4 Academics' Perception of the Communication Processes

In the model represented in Figure 3, communication is seen to be a key factor affecting the dissemination of the change from the top to bottom levels, as well as facilitating an exchange of ideas amongst people at these levels. The way that decisions are reached about curriculum change in the university has effects on academics’ involvement in the implementation process. Bottery and Wright (2000) asserted that for changes to occur, they must be understood, developed and owned by those whose culture is to change, and educational research literature has shown that a negligence of teaching staff’s beliefs
in implementing change will lead to disappointing results (Richardson, 1994). This section therefore discusses the effectiveness of the communication of the curriculum change.

The direction for curriculum changes originated at the governmental level, with the Ministry of Trade and Industry, which sees its role as interpreting and predicting economic trends and setting the direction for curriculum in the education system (Chapter Two, p. 12). This decision was handed from the policy-makers to the University, which was responsible to make relevant changes to the curriculum. This accounted for the academics’ responses that it was a top-down decision, that they had no part in the decision but were just expected to implement the change. This inevitably resulted in a process of implementation in the university, where the decision was discussed by management committee at the top of the hierarchy, passed down to committees below at the School level, and finally to the teaching teams of academics. This dissemination process reflected Schon’s (1971) first model of dissemination of change which was also the prevailing model in curriculum change in the 70s (Chapter Three, p. 37). The different committees discussed the changes to the content of courses and the combination of courses for students to take. However, the academics were not involved adequately in the discussions at the management levels. This inevitably led to the academics to be facing a number of problems.

There was no clear channel by which the academics and students heard of the curriculum change. The answers from the academics ranged from emails, to meetings in their divisions, and even the newspaper. The channel of communication of the change was important as it signaled the organization’s respect of their positions and involvement in the change. Marsh (1991) pointed out that whether teaching staff adopt an educational change is dependent on the effectiveness of communication they receive of it (Chapter Three, p. 150).
29). The worst source for academics to hear of the change is the newspaper since the fact that the public gets to know about it before them who are themselves members, show a disregard for their place in the organization. In a large organization like the university, it is a challenge to maintain effective communication. However, it is important that the staff are informed of the change before the news go out to those outside. For this reason, the academics interviewed felt that internal communication within the organization needed improvement. In addition, they desired a meeting to discuss this change. This indicates that they wished for a deeper level of involvement in the change rather than be told what to do. This was also a positive sign since the academics felt that their professional knowledge and input could help to improve decisions and implementation of curriculum change. The students, likewise, heard of the change either from the newspapers or friends in the senior years. They were largely unaware of the rationale for this curriculum change at the time they were admitted into the program. After experiencing this new curriculum for one semester, the students desired to have the freedom to choose their own combination of courses. This was a legitimate request since students at this age should have the freedom to exercise their choice of courses and they would also be more motivated. All these show therefore that more communication on the purposes and aims of this curriculum change was needed and feedback from those at the bottom level, the academics and students, were particularly important.

Communication and teamwork amongst the teaching group were, however, rated as very good amongst all the academics interviewed. Such teamwork was an important source of support for the academics who had to make changes in their courses within a short time as well as resolve problems that resulted. Generally, the cooperation amongst the teams helped to make the adjustments to their courses a smoother process. This strength could be
harnessed and utilized to improve on the implementation process. Huberman and Miles (1984) and Busher (1990) wrote that social interaction is an important element in educational change since change happens through a negotiation between people (Chapter Three, p. 26). Discussion about how students can gain the needed skills of flexibility, adaptation and innovativeness should also be carried out in these teams and feedback given to people at the top. To do this, bottom-up channels of communication must be made available. This is a discovery made in this study that this had not been predicted in the conceptual framework in Figure 3. Marsh (1991) pointed out that ultimately whether teaching staff adopt a change is dependent on the communication they receive of it (Chapter Three, p. 26). In addition, one academic expressed a fear of not knowing how his feedback would be received. This shows that if communication is only one way, namely, consisting only of passing information from the top to the bottom level, those at the bottom level lack knowledge of how people at the top think. This could result in a fear of censorship of ideas. The data of this study shows that the communication process shown in the conceptual framework represented in Figure 3 is inadequate. There should also be a level of trust that such feedback will be taken as constructive comments and that all involved desired an improvement to the present implementation process. The data collected from the interviews show, therefore, that there has to be a balance between the vision for the curriculum change cast by the policy-makers and input of the academics.

Hargreaves and Fullan (1992) explained that in educational change, there is often a tension between vision of the policy-makers and the opinions of the academics. They stated that in the process of implementing change, it is important to encourage this voice as a way of formulating purposes and priorities in the work (Hargreaves and Fullan, 1992). More communication and discussion about the curriculum therefore need to take place.
This can enhance their ownership of the change as well as allow them to deal with problems along the way.

6.5 Academics’ Responses to the Curriculum Change

This section discusses academics’ views of the effectiveness of the communication of the motivation, purpose and goals of the curriculum change. As seen in Figure 3, their responses acted as a bridge between the policy-makers’ plans and the students’ learning. Their responses consisted of their professional judgment of whether the adaptive aims of the curriculum change had been achieved and the pedagogical problems resulting from the existing implementation of the change. They also provided suggestions on how the implementation of the change as well as the existing curriculum could be improved.

According to the Committee on Singapore’s Competitiveness (1998), the focus of the curriculum should be on the training of skills and understanding. Also, there should be greater flexibility on assessment as well as syllabi. This shows that there should be a review of teaching methods, classroom activities and assessment. Classroom activities should engage students in discussion and application of knowledge. Case study as a teaching method could be used, for example, to take students’ learning beyond the classroom and projects used for assessment where students have to apply multidisciplinary knowledge. The problem with a focus on examinations is that it encourages rote learning (Chang, 1994) which is what this new curriculum wants to avoid. This also shows that it is important to involve academics in discussing what changes to make to existing teaching methods so as to meet the aims of the planned change. The dissemination of change falls short of helping the academics understand this purpose and motivating them to take up the necessary actions. Perhaps, there should also be greater flexibility in the assessment
methods. In other words, academics could be allowed to choose between projects, continual assessment or examinations. The students also have a point in saying that they should be given more choice in choosing the subjects to study. After all, if the goal is to greater flexibility, more choices should be given to students and academics.

There was a discrepancy between the academics’ professional judgment of what should be included in an engineering curriculum and the changes recommended by the Committee on Singapore’s Competitiveness (1998). On the one hand, the academics had their personal convictions of what should be taught in the engineering curriculum while there are also the pressing economic needs of the country. This tension was the result of uncertainty over how much breadth and depth to include in the curriculum. Academics should be involved in discussing the skills the planned curriculum hoped to achieve in students. In the implementation of the curriculum change, there was probably too much focus on the contents of the syllabus when it should have been on skills. By involving academics, they would have a greater ownership of the change. They would also be able to evaluate the curriculum diffusion as well as students’ learning. We see the same lack of clarity in the industries’ expectations of graduates.

It seems there was a diversity of views over whether the industries expected graduates to have broad, multidisciplinary skills or specialized skills. The academics in the interviews identified the kinds of industries which might be looking for either of these sets of skills. However, there was still a lack of clarity in this issue. One way of dealing with this issue is to allow students the choice of choosing between a broad or specialized curriculum. Students with specific interests can focus on certain specialized courses, while those who are interested in non-engineering courses like Business or Arts and Social Sciences can also choose those courses. In the past, the State controlled the kinds of
disciplines undergraduates take based on the needs of different sectors of economy. There were also clearer boundaries in job skills. Now, there is greater uncertainty about how the economy will develop or the skills demanded in the industries. Students should therefore be allowed more flexibility in choice of courses. This also shows that channels of communication were needed for students to inform policy-makers of the problems they encountered in the curriculum change. This study shows that there should therefore be more lines of communication than those represented in Figure 3.

The gap between the adoptive and adaptive aim of the change (Kelly, 1982) is the result of not devoting enough time to the implementation of the change as well as involving academics in the process. A hurried response to the directive to change can result in mere superficial changes. Time is needed to communicate the purpose of the change to the academics, influence their beliefs and attitudes as well as motivate them to change their teaching approaches. It could be seen that where the academics were unclear about the purposes of the change, they did not change their classroom practices. Consequently, students too failed to understand the aims of the change and were confused in their learning. This was revealed in the focus group discussion that the students failed to see how the courses are related or why they were taking the non-engineering subjects. This study shows therefore that communicating the curriculum change from the policy makers to the academics and students affects classroom teaching and learning. The next section proceeds to discuss the adoption of the change.

6.6 Curriculum Diffusion

This study does not assume that the curriculum carried out in practice would be the planned change as designed by policy-makers. Figure 3 in Chapter Three (p. 46) shows
that academics' responses affect the final outcome of the change. According to Hirst (1980), there must be an element of accountability in a curriculum in that it should be possible to justify the objectives and the means to reach them. In addition, Reid (1978) as well as Marsh (1991) felt that the curriculum must serve the economic needs of society (Chapter Three, p. 27). This elicits a need to constantly review the curriculum as stated by Limb (1992) (Chapter Three, p. 27). The question lies in what measures are used to review and evaluate the curriculum, especially with regards to how it meets the economic needs of the country. This section discusses therefore the changes made on the engineering curriculum.

The changes recommended by the Committee on Singapore's Competitiveness (1998) involve all the areas in the education system, from teaching approaches and methods, to assessment and curriculum. How these lead to students' learning outcomes such as flexibility, ability to learn new skills, resource planning and allocation, interpersonal skills and use of information, are very complex issues. These skills, especially those involving the personality of people, like interpersonal skills and flexibility, cannot be taught directly. One good method of helping students to acquire such skills will be to involve them in projects where they are required to work in teams and apply their knowledge (Karmakar 2001). It also cannot be assumed that teachers who have been used to teaching contents can make a sudden switch to teaching methods that will help students acquire these skills. Much time and thought need to be devoted to planning the curriculum and teaching approaches that will achieve this aim. In addition, the assessment system in Singapore is such that most of the emphasis is placed on the final examinations. These examinations, as described in Chapter Two, were found to be suitable criteria for employers to evaluate the abilities of the graduates they employ. If the education system
aims to inculcate understanding rather than rote learning in students, a more formative rather than achievement oriented assessment needs to be implemented. It was found that a heavily-weighted examinations system encouraged rote-learning in students (Chang et al., 1994).

Making changes in the engineering curriculum is complicated because of the need to train students in a dichotomy of skills and knowledge. According to Ditcher (2001), engineers need to be trained in engineering, social and business disciplines to prepare graduates to work in both engineering and non-engineering professions. It also prepares them to be promoted to management levels. The engineer's work involves both independent and teamwork. This aspect should be built into their university training. Such diversity of skills means more than just adding courses to the engineering program to make it multi-disciplinary. More thoughts should be given to teaching and assessment approaches as these can help students apply the knowledge of these disciplines in the real world. This need to balance the training of diverse skills in the engineering curriculum inevitably led to varying views amongst the academics on what should be taught. More than half of the academics interviewed expressed either dissatisfaction or concern that depth was being sacrificed for breadth in the curriculum. They felt that specializations in specific strands of engineering should not be sacrificed. Almost half the students in the focus group interviews showed the same concern of not having enough specialization in their engineering program.

The problems that resulted, as revealed by both the academics and students interviewed, were that students were confused and did not understand the rationale for them to take certain courses, especially those not related to the specializations they were interested in. This was also an indication that they did not fully understand the rationale
and justification of having a broad-based education. Secondly, it shows that more attempt is needed to help students see the relationship between disciplines and how knowledge from diverse courses could be applied in projects and different work contexts. Furthermore as the academics themselves did not believe in the rationale of the broadening of the curriculum, the students inevitably failed to do so. To begin with, the teaching staff must themselves believe in the curriculum change so that their teaching can be designed for students to grasp its rationale. Huberman and Miles (1984) wrote that the product of education consists of students' learning, and the fabrication of the product, the interaction between teaching staff and students (Chapter Three, p. 26). All these show that communication and dissemination of the curriculum change, represented by the arrows in Figure 3, are very complex processes that involve time. There is therefore a need to evaluate the nature of students' learning as well as the interaction between teaching staff and students. Academics' interaction with students inadvertently affects their learning and it is therefore critical that they embrace the curriculum change.

Structural changes were made to the curriculum in an attempt to broaden it. According to the Vice-dean interviewed, certain courses were moved to Year 3 or 4 levels, or postgraduate levels so that more courses can be fitted in the present curriculum. Many courses were also reduced by one academic unit each so that more courses could be fitted into the existing total units. The academics removed certain topics in their courses to adjust to this reduction in academic units. Such superficial and structural changes seem inadequate in meeting the aim of broadening the curriculum which was to instill in students skills such as flexibility, innovativeness and multidisciplinary skills. This is also exerted by Busher (1990) who said that it is inadequate to engage in a structural analysis of organizations as educational changes happen through a process of negotiation between
people (Chapter Three, p. 26). Returning to Figure 3, it can be seen that passing on the directive to change does not lead to effective implementation. How the curriculum can be made is a process that needs to be negotiated by the management, academics and students in the university. There is therefore a need to analyze the aim of the curriculum change, examine the contents of the courses to see the relationship between them and how they can be taught in a way that will help students both see these relations, and acquire the skills that the government felt to be important for them.

The way that this curriculum change is disseminated from the central academic committee, to coordinators, and academics, reflects Schon’s (1971) model of dissemination of change. This dissemination from the center, consisting of the people planning the change to the periphery, the academics teaching the courses, needs improvement. Firstly, in terms of communication, it is an ineffective dissemination method, as can be shown by the academics and students not having a full understanding of the change. Secondly, it does not permit the people at the periphery, in this case, the academics, to be involved in the initial planning of the change, which has been shown to be crucial in this case of the curriculum change. The academics should be involved at the onset of the implementation process in discussing how to broaden the curriculum, what will be useful for students to learn, how they can see relationship between courses, apply the knowledge they gain from different disciplines in practical ways and acquire the skills to cope with the new economy. This view is supported in Nisbet (1975) who explained that teaching staff should be involved in the planning and decision-making on educational change (Chapter Three, p. 28). The process of curriculum change should therefore be a cyclical one with people in the periphery being involved throughout and the evaluation process should be in place throughout the stages. Feedback from students was particularly important in understanding
the outcomes of the curriculum change in practice. This, together with the academics' feedback, will help to identify the problems involved in the implementation process. As Nisbet (1975) indicated, the success of a curriculum change is dependent more on social relationships within the educational institution rather than the nature of the change itself. There is therefore a need to build consensus amongst the staff as well as between staff and students in order to elicit their support of the change. Failure to do so leads to a number of problems in the process of implementing the change.

A serious problem with the implementation of this curriculum change is that it resulted in an overload of courses for the students to learn. This arose from fitting more courses into the existing curriculum. What resulted was not a learning of skills like flexibility and innovativeness but a cramming of different content areas. The students then adopted coping strategies such as memorizing course content in order to pass examinations. This also means that they were engaged in superficial learning rather than deep learning of practical skills, which was the 'adoptive aim' of the curriculum change (Kelly, 1982). This shows that there was a gap between curriculum dissemination and curriculum diffusion (Kelly, 1982), in the sense that the planned change was different from what happened in practice. Such a gap can be closed by strengthening the communication and interaction of people involved in making the change and increasing the participation of those at ground level, namely, the academics and students. The next section therefore discusses the effects of the change on the students.

6.7. Academics' Adoption of the Curriculum Change

The academics' adoption of the curriculum change is affected by how they perceive and respond to the change. This is the final stage in the implementation of the curriculum
change as shown in Figure 3. The outcomes of educational change are subjective and found in what the students ultimately learn (Huberman and Miles, 1984). One of the interview questions posed was therefore how students’ learning is affected by this curriculum change. This study examines both academics’ and students’ views on this issue. This section begins by discussing the students’ expectations of learning; the problems they encounter in the changed curriculum and how they perceive this change as helping them acquire the skills needed in the knowledge-based economy.

It seems that there was a prevalent concern among the academics and students that there was less specialization in the engineering curriculum. This could be disadvantageous to students who intended to specialize in certain strands of engineering. A few of the academics and students felt that it was specialization in engineering courses that employers sought. A few of the other students felt however, that there were advantages in having a broad curriculum. Marsh (1991) explained that the curriculum change must be compatible with existing values and experiences. Effort needs to be made therefore to align the values imparted by the planned change and those of students as well as academics. This is clearly seen in the views expressed by academics and students in the interviews.

A number of issues emerged from the responses given by the academics and students. Firstly, there was the mismatch between students’ expectations of their engineering program and the new curriculum. It is important to address this mismatch as it results in confusion and frustration amongst the students as they did not take the courses they were interested in. These have a serious effect on their assimilation of the knowledge taught in these courses. Due to the fact that all the courses in this broad curriculum were prescribed, the students resorted to memorizing information, resulting in superficial learning. This shows that the aim set out by the Committee on Singapore’s
Competitiveness (1998) which was to help students gain understanding rather than engage in rote learning was not met. The broadening of the engineering curriculum in the way that it was implemented further pushes the students to resort to rote learning. Attempt should therefore be made to help the students understand the rationale of the broad curriculum, give them choices of courses and reduce course contents.

A majority of the academics and students interviewed agreed on the overall goals of the broadening of the engineering curriculum, which were to prepare students for an uncertain future and the changing nature of work. What they disagreed with was the effectiveness of the curriculum change in achieving these goals. This shows that there is clearly a discrepancy between the curriculum dissemination and curriculum diffusion (Kelly, 1982, Chapter Three, p. 38). One of the students commented aptly that if they were expected to acquire the skill of flexibility, then the curriculum must be flexible. Freedom should be granted for them to choose subjects they were interested in. Four of the academics interviewed felt however that the contents of the courses were not as important to the students as the fact that they were flexible to adapt to changes. This shows that the focus of this curriculum change should not just be the kinds of courses offered to the students but how they develop the skills of flexibility and innovativeness through the teaching methods, activities and assessments they are given.

Therefore, the dissemination of the curriculum change should not be a single directional process of policy-makers handing down directives to change as shown in Figure 3. The communication of the problems encountered from the bottom to top levels, and the effectiveness of the implementation are very important. The planning of the change, in other words, must involve people at various levels: the policy-makers, the management in the university, the academics, as well as the students. This study also
shows that the adoption of the change is influenced by something as subjective as academics' responses to it which in turn are influenced by organizational factors. In essence, Figure 3 captures the overall factors influencing the effectiveness of dissemination of a curriculum change.

Based on the findings of this study, it was discovered that the communication of the curriculum change was very important, and had direct impact on academics' adoption at the end of the dissemination process. This communication should consist of not just passing down a directive or instructions, but helping academics and students understand the motivation, purpose, goals and direction of the change. In addition, bottom-up communication in terms of academics and students giving feedback on the curriculum diffusion to the management level was crucial so that problems could be addressed. Communication amongst the teams of academics was also very important. In addition, it was found that the effectiveness of this communication in turn determined the degree the academics were involved in the implementation process and the changes they made to their teaching. The whole process also involved a change of thinking, attitude and belief about teaching and learning which was found to be more complex and involved more time than was realized by the policy-makers. The findings of this study therefore led to adjustments in the conceptual framework represented in Figure 3. The result is a model that can better represent the factors influencing curriculum change.

The data gathered in this study show the considerations needed in each area of the conceptual framework, as depicted in Figure 3, before effective curriculum diffusion can take place. These considerations are included, in italics, in the conceptual framework shown in Figure 4.
Based on the findings obtained in this study, Figure 4 is a revision of the model illustrated in Figure 3. The development from Figure 3 to Figure 4 is firstly that it shows curriculum change as a cyclical rather than linear process. In addition, the beliefs that
Figure 4 is based on are different from those underlying Figure 3. Furthermore, Figure 4 shows the considerations required for each stage, such as 'communications', 'involvement' and 'adoption of the change' as derived from the data in this study.

The development from Figure 3 to 4 is that it shows the implementation of curriculum change as a cyclical rather than linear process. Figure 3 is based on Schon's (1971) center-periphery model while Figure 4 shows that curriculum change occurs in a cycle beginning with the implementation, moving towards feedback from the academics to the organization of the outcomes of the change. This process is continuous, and can develop into more cycles with further adaptations made to the curriculum change. The reason that curriculum change must be seen as a cyclical process is because firstly, feedback from the academics to the management is very important as found in this study. Secondly, it involves a few rounds of evaluation and adaptations. From this study, it is shown that evaluation of the curriculum change is important as there are a number of problems related to teaching and students' learning that were unanticipated at the initial stage of the planning process. It is crucial therefore to ensure sustainability of the curriculum by carrying out evaluation. Thirdly, further curriculum changes should be introduced in a way that takes into consideration the present change and its outcomes. It is only in doing so that educational wastage can be avoided. Central to the conceptual framework shown in Figure 4 are therefore different criteria from that represented in Figure 3.

Figure 4 shows that channels of communication should be available for academics to give feedback on effects and outcomes of the curriculum change to the management. It also assumes that such feedback will be taken into consideration and relevant adjustments made. It is found in this study that such feedback is very important as the academics and
students are the ones who encounter the effects of the change and experience the outcomes as well as problems. It is also crucial to ensure improvements in the curriculum from lessons learnt through implementation of the change. In addition to such a perspective of curriculum change as a cycle, there are also different considerations at each stage that the academics go through.

Regarding the context, there was an agreement that the economic situation globally results in demand for different kinds of job skills from those of the past. This forms the purpose of the curriculum change that must be communicated to the university’s management as well as academics. Under the category ‘communication’ in Figure 4, purpose of the change is therefore listed. The purpose then leads to the formulation of goals which then guide the design of learning objectives, teaching approaches and classroom activities. It is important therefore that academics have complete knowledge of the purpose of the change. Such complete knowledge then allows the academics to be actively involved in the implementation process.

From this study, it is found that academics’ ownership and commitment to the curriculum change can only happen if communication of the purpose is effective and they are involved in both the decision-making and implementation process. Therefore, Figure 4 shows ‘communication’ leading to ‘involvement’. It is also discovered that two considerations are important in this stage. Firstly, adequate time should be given for them to adapt to it. Secondly, this study also discovers that effective collaboration amongst the academics acts as an important support for them to adapt to the curriculum change. Understandably, time and positive interpersonal relationships will facilitate relevant change in the academics’ attitudes and beliefs about teaching. This study shows that this change is needed before their teaching approaches change.
In Figure 4, it is seen that academics' involvement in the change process will lead to their adoption of the change. This consists of appropriate changes to teaching approaches, classroom activities and assessment methods. In this area, it is discovered from the interviews that the academics have some ideas of the kinds of teaching approaches that befit the purpose of the curriculum change. They mentioned teaching approaches such as those that encourage critical thinking and independent learning. This shows that the academics, based on their professional experience and judgment are able to reach the conclusions of appropriate teaching methods. It is important therefore that channels of communication are available for them to provide this feedback to the management.

Therefore, the arrow in Figure 4 links academics' adoption of the change with the organizational factors, thereby closing the circle. Such feedback from the academics must be taken seriously by the management, which, in turn, must see that teaching and learning are the key factors determining the success of the curriculum change. Secondly, the management must also understand that the planning of the curriculum is not a one-time event, but is a continual process involving an initial planning, evaluation, changes and further planning. It is seen therefore that consistency and commitment are very important and a curriculum change cannot involve only a small group of people, such as the policy-makers or curriculum committee, but everyone, including the academics and students.

Each of these areas and factors will be elaborated in the next chapter entitled 'Conclusions'. This chapter has discussed the implications of the data collected. The findings in this study confirm the writings on educational change about the importance of communication and the academics' involvement of curriculum change. This study has cast
new insights that a close relationship exists among the communication, the academics’
responses and their consequent adoption of the curriculum change.

This chapter has therefore discussed the issues related to the following areas of this
curriculum change which are the motivation and nature of the change, the effects on
academics and students, the responses from the industries and the implementation process
of the change. These issues have implications on firstly, academics’ professional
involvement in the organization; students learning and the management of curriculum
change in the university. The findings of this study have been examined in the light of the
research literature on educational change. The next chapter proceeds to draw conclusions
from these findings, recommend improvements on the way educational changes are made
in Singapore as well as discuss the implications for further research.
CHAPTER SEVEN
IMPACT OF CURRICULUM CHANGE ON ACADEMICS:
CONCLUSIONS

7.1 Introduction

This chapter delineates the conclusions drawn from the interviews conducted on the School’s academic staff and documentary analysis. From the findings of this study, the factors influencing the implementation of curriculum change were identified and represented in Figure 4 in the previous chapter (p. 164). According to Etzioni and Lehman (1980), Taba (1962) and Reid (1978), both organizational factors and people’s involvement are important in studying educational change (Chapter Three, p. 44). In this study, it is learned that the organizational structures can either limit or provide opportunities for the academics’ involvement in educational change. This implies that the organizational structures can be changed to facilitate greater involvement from the academic staff. In addition, if only organizational changes are made without changing the beliefs and attitudes of the academics and students, it is virtually impossible to implement educational changes effectively. Consequently, this chapter discusses the conclusions drawn from the data in each area in the conceptual framework illustrated in Figure 4 in Chapter Six (p. 164).

It was found in this study that two factors are crucial for the success of change implementation. These are academics’ involvement in decision-making and the effectiveness of communication of curriculum change. Figure 4 in Chapter Six (p. 164) shows how these two areas and other factors are needed for the implementation process to be carried out effectively. The views contained in both the documents and interviews also show an unquestioning attitude towards the need to change, similar to Blenkin’s et. al. (1992) third perspective of change. This means that organizationally, the University
has to be flexible and responsive to external changes. Therefore, this chapter draws conclusions about the effectiveness of the change implementation given the existing organizational structures in the University. In addition, it discusses how the implementation process can be improved to ensure that the aims of curriculum change are achieved. This implementation process should take into consideration the context of the educational scene in higher education in Singapore. This chapter begins with a discussion of the consensus about the vision of the curriculum change. This is followed by a discussion of the appropriate teaching approaches and assessment to achieve the desired learning outcomes. This chapter also offers suggestions on how communication can be improved in the entire process. Finally, it ends with a discussion of the context of educational changes in Singapore and the problems relating to this.

7.2 Academics' Involvement in the Implementation of the Curriculum Change

There are two external forces that drive educational change in Singapore and place pressure on the Universities to change their curriculum. The first is the need to change the economic strategy to adapt to the global trends. It seems that the organizational structures of the university play an important part in enabling it to respond quickly to such unpredictable changes. These structures can facilitate and communicate change to teaching staff and students. Alternatively, they can hinder these. This study shows that there were inadequate channels of communication for effective transmission and feedback of the educational changes. The interviews conducted with the students and academics showed that there was extensive confusion about the goals and purposes of the curriculum change. It seemed that students and academics were vague about the source of the change. This brought about ambiguity among those most affected by the change and lack of understanding of how to implement it effectively. Consequently, the academics resorted to the coping strategy of
making superficial changes to their syllabus, and students engaged in rote learning just to pass the examinations. Therefore, in the revised conceptual framework represented in Figure 4 in Chapter Six (p. 164), two important considerations were stated. One of these was the provision for channels of communication for the academics to discuss the curriculum change. It is also essential to review the organizational structures of the university to see how they can be made more flexible and responsive to external changes as well as facilitate more effective communication. This may entail flattening the hierarchical structures which can be a hindrance to communication.

There is also a need to evaluate the approach taken in Singapore to implement educational changes, which reflects that used in business. The expectations are that ingenious planning of educational changes will lead to good learning outcomes. This can be shown in the discrepancy between planning and implementation of this curriculum change. The broadening of curriculum has been planned for a few years and the plan is impressive as shown in the data collected from documentary analysis in this study. However, from the interviews conducted, it was evident that it was implemented in an unrealistically short span of time and not much thought was given to this. Education is different from business in that the process is not so straightforward. It also takes much more time for the effects of educational changes and learning outcomes to be seen. This study shows that there is inadequate discussion between the policymakers and educators. We find that the curriculum change can be more effectively implemented if the educators are able to inform the policy-makers of the complexity of educational changes, the University as an organization, the problems faced by academics in implementing changes, and the possible effects on academics as well as students. Consequently, Figure 4 in Chapter Six (p. 164) shows the curriculum implementation and communication flow to be an ongoing and cyclical process.
The rapid changes in the global economic scene lead to changing types and nature of jobs. This poses difficulties to the Universities in Singapore as they cannot predict the kinds of jobs that will be available to their graduates. Such uncertainties are reflected in both the academics' and students' mixed responses to the curriculum change. This situation leads the government to advise the Universities to train students in skills of flexibility, and life-long learning. Since the focus of education is no longer knowledge, but skills, teaching and assessment approaches are crucial. Teaching approaches must encourage students to be involved in critical thinking, application of knowledge, skills and teamwork. Likewise, assessment methods must reward such skills. Contrary to this, this study shows that there was inadequate time for the academics to discuss suitable approaches to teaching to produce the desired skills. They were simply told to change their syllabi. As the students were required to take more courses now, the academics merely remove few topics from their syllabi to adjust to the reduced number of credits. Inadequate consideration was given to appropriate teaching approach and classroom practices. In the interviews, the academics revealed that they carried on teaching in the same way and students failed to see how their learning had changed to be broader and more flexible. Therefore, this study shows that for the goals of this curriculum change to be achieved, more needs to be done apart from changing the combination and syllabi of courses. Teaching approaches have to be reviewed and academics should be involved in such discussions since they are the practitioners. The academics should discuss appropriate teaching approaches in their divisions and such input should be communicated to the Curriculum Committee. Their feedback should be taken seriously in decisions to change the curriculum. Otherwise, they will stop offering their views. In addition, since the future economic climate is so unpredictable, individuals' viewpoints should be encouraged so as to arrive at the best solutions to
these diverse situations. Certainly, the academics' input is instrumental, considering their expertise and professionalism.

In Chapter Two, we discussed that the government's policy of liberalization and decentralization in educational institutions is motivated largely by the uncertain economic climate locally and globally. The dissemination of change, however, happened in a top down manner through the hierarchy in the universities, due in part to the bureaucracy in the universities. This inevitably results in a loss of communication, leading to the academics' vague and sporadic knowledge of the curriculum change's purposes and goals. Subsequently, they were unable to implement the change effectively and resorted to superficial changes in compliance with directives from the top. In this study, it is found that due to an urgency to implement educational changes, communication suffers. Hence, the government's new policy necessitates a reform of the organizational structures in the educational institutions so that they can be flexible and responsive to external changes. This is especially the case with the Universities as they are expected to produce graduates with relevant skills and expertise that are critical in sustaining economic growth.

The political and economic scene in Singapore and worldwide are marked by changes. This makes it crucial to invite diverse suggestions on how to best survive in such circumstances. As such, it has become important for people at the lower levels in the University's hierarchy to give feedback to those at the higher levels of management. This is particularly true when it comes to curriculum changes as they affect students' learning. In this study, it is discovered that it is important to provide channels for face-to-face interaction where the academics can clarify the goals of curriculum change and present their views. The academics also need to know how their views are being considered in policies regarding curriculum change. Returning to Figure 4 in Chapter Six (p. 164), this study shows that the context of educational change, in terms of
political and economic policies, affects the dissemination of the change and ultimately, the academics' responses. In addition, this study shows that there should be more analysis of the method and time the University needed to produce the desired skills. Educational changes can then be planned in a longer term and more consistent basis. In addition, an evaluation of the process and outcomes can be carried along the process.

The conceptual framework of this study, as shown in Figure 4 in Chapter Six (p. 164), shows that organizational factors affect the communication of the curriculum change which in turn influence the academics' commitment to it. From the interviews, it is seen that the dissemination of the curriculum change's vision and goals were ineffectively communicated from the Academic Board, Curriculum Committee and to each committee in the division. All the interviewees admitted that they were not aware of the curriculum change's goals nor could they remember any meeting or briefing to inform them about these. In the interviews, it can be seen that this results in the academics lacking ownership of the change. It also leads them to think that the policymakers know best how the educational system can meet the national needs. From a pedagogical perspective, the undesirable effect is that the academics lacked conviction and knowledge of how to change their teaching approaches. As a result of this lack of clarity of the goals, the academics were also unable to work out the students' learning outcomes to align with the change. This explains why they said that very little, if any, change had occurred in their teaching approaches. Subsequently, there is a need to improve communication both in the organization as a whole, and in the implementation process.

This study shows a need for the process of the change implementation to be more transparent to the academics. In addition, academics should be involved by discussing the steps of implementation in their divisions. There should also be effective
interaction and exchange of views between the academics at the management level and division level. This can be done by having frequent meetings between both parties.

The conceptual framework shown in Figure 4 in Chapter Six (p. 164) depicts academics' responses as the key factor affecting the outcomes of the curriculum change, consisting of teaching approaches and students' learning. Taba (1962) wrote that it is impossible to change curriculum without changing people and institution. Interviews with the academics and students showed that they desired more channels of feedback to the management on the curriculum. Judging from the problems encountered by them, there was a need for a channel for academic staff to give feedback at every stage of the change process, from its conception, to planning, implementation and lastly evaluation. A few of the academics pointed out that this could lead to diverse viewpoints showing that a way of reconciling these wide-ranging views should be developed. There should therefore be opportunities and channels for academics to provide feedback, review the curriculum change and give input on how the implementation process can be improved. This study shows that in the implementation process, if effort is not made to change academics' thinking about teaching, their teaching approach remains the same. One important area that needs to be reviewed, therefore, is teaching approach and this was neglected in the present implementation of the change. In other words, after the change is effectively communicated to the stakeholders, there is still a need to influence academics' attitude and beliefs about teaching. For this reason, Figure 4 in Chapter Six (p. 164) describes the academics' adoption of the curriculum change in terms of changes in their teaching approaches, classroom activities and assessments.

It is discovered from the findings of this study that there is a big gap in the implementation process and adequate preparation and training for the academics to make the change. In the amended model (Figure 4, Chapter Six, p. 164), factors like
time and adequate support to influence beliefs are added to the original model depicted in Figure 3 in Chapter Six (p. 46). From this study, it is seen that until these factors are addressed, no change will happen in the last stage of Figure 4 (Chapter, Six, p. 164), which is the academics' adoption of the change.

The conceptual framework as shown in Figure 4 (Chapter Six, p. 164) holds that involvement in the change process is a crucial factor affecting academics' responses to change. This involvement includes their teamwork. The interviews with academics showed that they rated their collegiality favourably. This is a strength in the School that can be harnessed and utilized. With regards to collaboration, all the academics interviewed claimed they had worked well together. In the face of the tendency to force educational change through externally imposed restructuring and reform, as is the case in Singapore, it is important to balance this with an emphasis on improving internal interactions and relationships in the institution (Chapter Three, p. 24). The unity and support amongst the academics enabled them to tide over their uncertainties, struggles with difficulties accompanying the change and students' learning as well as conflicts with their personal convictions about the engineering curriculum. The academics should be encouraged to discuss these issues and other related issues in working out how implementation of the change could be best done. The University should increase channels of communication with the academics, and seek their views on how the change can be effectively introduced. This means that there should be more bottom-up communication as well as participation in the change process. Consequently, the amended model, as depicted in Figure 4 in Chapter Six (p. 164), includes factors like decision making, implementation and evaluation of the change as part of academics' involvement.

With regards to the academics' adoption of the curriculum change, this study shows that academics' responses, a key factor in Figure 4 in Chapter Six (p. 164), affect
their adoption of it. Deep change, in fact, requires involvements of the participants in working out both the goals and processes of change and the teacher is the one responsible for resolving the conflict between means and ends in education (Richardson, 1994, Chapter Three p. 28). This means that the academics are the ones to reconcile the aims of the planned change with their teaching practice. This study shows that inadequate time was given for this to happen. The interviews with the academics and students showed that what resulted was the teaching approach remained the same and the courses students had to take increased. Students therefore were overloaded with courses and their learning was affected. The model shown in Figure 4 (Chapter Six, p. 164) depicts, therefore, the stages that the academics would have to go through before they change their teaching practice. Complete knowledge of the change is necessary for them to be adequately involved in the implementation of the change, and ultimately, their teaching to be changed. Subsequently, Figure 4 (Chapter Six, p. 164) shows a process of change that requires time and effort for the academics to change their mindsets, rather than an automatic response.

Without considering the participants' views, classroom practices do not change. This means that there is a need for academics to reflect on their present teaching approaches and consider how these need to change in order that students are trained in the relevant skills. Their involvement in how problems arising from implementation of the curriculum change can be solved is crucial, and they are also the ones who can say how teaching practices are meeting the aims of the change. Consequently, there is a need to increase their involvement in the entire process of curriculum diffusion. Thus this study confirms Etzioni and Lehman's (1980), Taba's (1962) and Reid's (1978) theories that educational change involves both the organization and people. This study has demonstrated that if educational change is planned solely at an organizational level,
ignoring the people within the institution, no change in teaching and learning in effect occurs and alternatively, confusion results.

In fact, as Reid (1978) explained, the curriculum is the result of a balance between the way the organization achieves its task and teachers relate to students. In other words, curriculum change involves three elements: the process of dissemination of the change, teaching approaches and students’ learning. In the case of the curriculum change in the present research, it is shown that greater understanding of academics’ and students’ perspectives and experiences is needed. A point which all the interviewees agreed on was that the change was introduced from the top down and an incorporation of bottom-up views would be useful in the process of making this change. This also means that much more time has to be devoted for implementation and evaluation of the curriculum change than what has taken place. One way of gathering bottom-up views is to have representatives amongst the academics in the different divisions and student representatives to present their opinions to the management levels. The management can then work out the consensus by examining the areas that most people agree with and communicate to those below. They can then reveal how decisions about the curriculum are reached from a reconciliation of this consensus and the government’s broader visions and aims. The new President of the University has also encouraged bottom-up views by allowing students and academics to email him on any issue in the University.

It can be seen that more understanding about how educational change can be effectively implemented is needed in Singapore. The new President of the University in his inauguration speech in 2003 talked about broadening the curriculum even further by allowing engineering students greater choice of courses across disciplines (NTU News, April-June 2003). In this study, the Vice-deans and Sub-deans interviewed also confessed that the curriculum planners were in the process of learning about how to
broaden the curriculum. It is recognized that improvements on the system will be made with each subsequent academic years. It is also realized that more thinking should be done about teaching approaches that will cultivate the attitude and learning in students that befits a broad education. It was gathered in the interviews that such teaching approaches would encourage greater teachers’ and students’ interaction. In addition to imparting knowledge, they would involve students in critical thinking, particularly on real life situations, and assess students based on their teamwork and problem-solving skills. Greater consideration should be given to what happens at the ground level, in terms of the state of interaction between teaching staff and students. Further study can be done about what are the appropriate classroom practices that will lead to broader knowledge, active learning and lifelong learning. There are two important factors regarding the context of Singapore’s educational system. These are the rapid rate in which changes occur and the external introduction of these changes. Both these factors can result in problems in the implementation process. Consequently, there is a need to think about how these problems can be solved.

In essence, it was found in this study that there was no resistance amongst the academics to the vision of the educational change introduced. The issue lies with the implementation of the change, namely, in the areas of feedback and decision-making. It seems that when academics were not involved in these, their beliefs about education and teaching remains unchanged. When this happens, it is questionable that teaching practices and student learning have changed. When this change filters down to the level of the academic staff and teaching, in effect, very little change occurs. Figure 4 in Chapter Six (p. 164) depicts the conditions that are important in terms of their involvement in the curriculum change, namely, in the decision-making, implementation and evaluation processes. Figure 4 (Chapter Six, p. 164) shows that how change is disseminated from the top to bottom levels is important and an improvement in
organizational structures can make it more effective. This study proves that unless the academics in the present University are involved in discussions on the appropriate teaching approaches to accomplish the goals of the curriculum change, very little change will occur. This is because they teach from an inner conviction about what is important for the students to learn and they need to believe in the goals of the curriculum change themselves before they will adjust their teaching approaches accordingly. Further studies can therefore be done on their experiences in the stages (Figure 4, Chapter Six, p. 164) that they go through in adapting to a curriculum change.

7.3 Key Improvement and Reform Strategies

In this study it is discovered that it is important to review the process in which educational changes in Singapore are planned and implemented, by examining appropriate teaching approaches and strategies. Appropriate strategies need to be developed bearing in mind the circumstances that drive educational changes in Singapore.

Educational changes in Singapore happen at a rapid rate. In addition, the curriculum is quite heavy and students have to study a large number of subjects, totaling about seven per semester. In this study, it was found that when a change was introduced, both academics and students resorted to coping strategies by making minimal surface changes in order to show their compliance. This resulted in an ineffective implementation of the change. This study shows that for organizational learning to take place more effectively, there is a need to evaluate such changes and take into account the lessons learned so that the processes of future change can be improved. In such an evaluation, the views of both students and academics should be collected and examined. There should be an attempt to solve problems arising from the
implementation of the change and make improvements. Referring to Figure 4 (Chapter Six, p. 164), any new change introduced should be brought into the same cyclical process. In other words, additional curriculum change should be introduced in such a way that takes into consideration the outcomes of the previous change. The policy-makers should move from an attitude of jumping on the bandwagon to one of learning from past lessons and improving on the current situation. In this way, educational wastage can be reduced and effectiveness curriculum change maximized.

In the face of accelerated rate of change in the global scene, the strategy for survival, for both the nation and educational institutions, is ‘sustainability’ (Towards a World Class Education System through Enlightened School Management/Leadership and Meaningful Educational Activities, A View from the Singapore Teachers’ Union, 2000, p. 12), meaning to be able to keep going and replacing old information with new knowledge. This element of sustainability is a problem for the present University. The academics complained of constant curriculum changes and they were unaware of the rationale for these changes. In addition, they were frustrated with having to write new courses which would be removed the following year. In this study, it is seen that frequent top-down educational changes is self-defeating and insensitive to the situations of the academics as well as students. Consequently, Figure 4 (Chapter Six, p. 164) shows a cyclical process of change implementation as there is a need for a two-way communication process between the academics, management and policy-makers.

A possible solution to such a situation is to develop a longer-term direction in educational changes. In addition, it is hard to pay attention to individual student’s learning style when the teaching staff is faced with heavy workload on the one hand, and coping with frequent changes on the other. Change takes up tremendous amount of time, resources and effort, as training sessions need to be organized to equip teaching staff; briefing sessions need to be held; new resources provided and teaching
approaches changed. Much of the teaching staff's time and attention will be channeled here, leaving less time to finding out how students are adapting or learning with the change made. This study establishes that it is important to train academics when a curriculum change is introduced.

This study shows that there is no formative evaluation of the curriculum change after it was implemented. As a result, there was no notion of the strengths and weaknesses of the curriculum change, as well as lessons that could be learned from the entire process. Effective evaluation procedures needed to be implemented alongside educational changes. The problems with successful implementation of change in educational institutions in Singapore are identified by Singapore Teachers' Union (Towards a World Class Education System through Enlightened School Management/Leadership and Meaningful Educational Activities, A View from the Singapore Teachers' Union, 2000) as a failure to relate change objectives to existing practice and the pace of implementation with practical realities in educational institutions (Towards a World Class Education System through Enlightened School Management/Leadership and Meaningful Educational Activities, A View from the Singapore Teachers' Union, 2000). It is discovered in this study that these changes should be consistent with specific development or strategy, as conflicting changes will only result in more damage to staff morale.

The academics interviewed seemed rather confused about the frequency of changes and how this specific curriculum change could help students learn better. They also felt that such frequent changes led to some educational wastage such as the academics spending a lot of time with course preparations only to have these courses removed the following year. Evaluation procedures of curriculum change should include academics in discussing and evaluating the effectiveness of the change implementation. Feedback should also be collected from the students and academics, as
shown in Figure 4 (Chapter Six, p. 164). Discussions of further adjustments in order to implement the change more effectively could then be carried out. This entailed commitment to the curriculum change. It would have been better to have this ongoing evaluation of a change than to make changes one after another without due consideration of what had taken place. This also means that academics, both at the management and teaching levels need to devote a considerable amount of time to the planning and evaluation of the curriculum change. Therefore, there should be a careful review of their responsibilities. How they can be relieved of certain administrative or paper work should be considered so as to as to give their time to make the curriculum change. At present, the bureaucratic system in the University places a tremendous pressure in terms of paper work on the academics. It is important that this paper work be reduced so that they can focus on other important matters like curriculum changes.

This study shows that in introducing a curriculum change, it is important to foster a positive working climate through teamwork and collaboration. The academics interviewed pointed out that it was their effective teamwork that helped them make changes to their syllabi within a short time. Effective teamwork encourages members to communicate in an open manner so as to develop trust, harmony and positive working relationships. This positive collaboration can be harnessed and academics can be involved in planning curriculum change in tandem with the policy-makers. Referring to Figure 4 (Chapter Six, p. 164), effective communication amongst teams of academics is also an important factor in successful change implementation. Practitioners at the bottom level can provide input to those at the top, thus, as shown in Figure 4 (Chapter Six, p. 164), the planning can be an iterative process, with the arrows going in both directions.

The curriculum change in the present study was motivated by an economic need that required graduates to possess flexible skills. It can be argued that the concerns
of education should go beyond economic and employment preoccupations, that such an attitude towards education can result in reductionism (Brennan et. al., 1996). The survival of the nation is a pressing and important need resulting in the nation as a whole to hold a view of change that is congruent with what is written in Blenkin et. al. (1992). However, the objectives of education should go beyond this. This study shows that there is a need to reconcile educational principles with economic demands. If economic demands supersede educational principles, it is self-defeating as the desired learning outcomes may not result.

This study shows that the students are required to take so many courses that they resort to rote learning. This may hinder the students from acquiring the skills of flexibility and adaptability. In the age of the knowledge-based economy, employers are more concerned with graduates' skills, attitudes and ability to learn (Brown et. al., 2001, Chapter Two, p. 15). Gopinathan and Sharpe (2001) identified the qualities needed in the knowledge-based economy as ‘flexibility, risk taking, entrepreneurship, the ability to change and a commitment to lifelong learning’ (p. 24). In view of this, education, in particular, higher education, should encourage students to take initiative, responsibility and risks to learn new things. This also requires students to engage in deep learning rather than surface learning. It is essential therefore not to overload their curriculum as students will resort to surface learning (Chang et. al., 1994) if they are faced with too much content to learn. Instead, the curriculum should aim at helping students acquire skills through appropriate teaching methods and assessment. This entails a radical change to teaching approaches and classroom activities. More evaluation, therefore, needs to be carried out, on what actually happens in the teaching of courses.

External circumstances can instill in individuals a sense of the need to change. They can result in what Blenkin et. al. (1992) described as the belief that change is
inevitable in adapting to an ever-changing environment. This belief in itself does not mean that individuals will be motivated to implement a planned change nor the success of its implementation. People also need to have complete knowledge of the purpose and goals of the planned change. In the case of educational change, time is needed to communicate the purpose of a curriculum change to academics, students, and others involved and affected by it. Adequate knowledge of the planned curriculum change is needed to inform academics of the appropriate actions to implement it. Partial knowledge and lack of clarity will result in frustrated efforts and superficial change, that is making minimal changes just to please the people at the top.

Dimmock and Walker (2000) pointed out that in Southeast Asia, policymakers believe education to be the key to their nations' development but further growth can be handicapped if the emphasis on centralized decision-making and rote learning does not change. They felt that educational institutions must be learning organizations and by increasing the capacity for learning in the workplace (Dimmock and Walker, 2000). Learning should take place within the institutions so that they can respond readily to the changing environment (Dimmock and Walker, 2000). In the case of Singapore therefore with the uncertain and changing economy, and an attempt to liberalize educational institutions, much learning is needed about how organizational structures can be made flexible to external changes, and at the same time, produce the desired learning outcomes in students.

After being informed about the purpose and nature of the change, academics also need to be involved in its implementation, not just in terms of executing the plans, but also in the process of decision-making and evaluating the outcomes. This stage of involvement is important to elicit their commitment and ownership. Time is needed in each of these stages for academics to progress from acquiring understanding of the change to having their belief system and attitudes shaped by it. Patience is also needed
as each of these stages has to happen before the next stage can occur. Knowledge of the change is needed, for example, before academics get involved in the change. This concept of curriculum change can be represented in Figure 4 in Chapter Six (p. 164).

This study supports Etzioni and Lehman's (1980) theory that organizational structures are important in educational change. The findings in this study show how important it is for these structures to facilitate open communication, and shaping of individuals' beliefs and attitudes. For this reason, Figure 4 shows the stages of change in thinking and attitude of the academics. In other words, in implementation of educational change, the focus must be on people and not simply programs. In the case of a top-down change, it is crucial to give time for people to absorb and implement change. This study also proves Taba (1962) and Reid (1978) to be right. It is impossible to change curriculum without changing people and institution (Taba, 1962), and the curriculum is the result of a balance amongst the technology; social system and theory in the educational institution as an organization (Reid, 1978).

Consequently, this study has shown that academics should be involved in every stage of a curriculum change. For this reason, the model depicted in Figure 4 talks about academics' involvement at all levels of the curriculum change. This entails a greater respect for their viewpoints and acceptance as well as reconciliation of diverse views. Time and communication need to be devoted to the planning and implementation of curriculum change for both academics and students to be sufficiently influenced by its purpose such that their personal beliefs and attitudes can change. If this process happens, they will have a deeper commitment and ownership to the change. In addition, to cope with the unpredictability of economic development in Singapore and the world, the diverse views of individuals, especially professionals like the academics, should be encouraged so as to reach creative solutions to the situation. It is recommended therefore that organizational structures be reformed to allow for
greater communication and involvement amongst the academics. It is vital that the outcomes of curriculum change are evaluated so as to prevent educational wastage. If changes are allowed to happen one after another, both teaching staff and students will be overwhelmed and confused, leading to a sense of helplessness over the situation. The context in Singapore is such that the educational system has to adapt to changes in the industries. However, education is unlike business (Chapter Three, p. 24). Much more time is needed for the outcomes of change to take effect and for these to be evident. Education therefore cannot be treated like business where it is expected to change with the tide. A longer-term and more sustainable strategy of educational change needs to be developed so as to reap the benefits of the change. This situation also calls for more research on both the process and evaluation of educational change in Singapore.

Methodologically, it is discovered in this study that qualitative approach is suitable for the study of educational change in a context like Singapore where no study has been conducted in this area. Such approaches highlight the experiences of teaching staff and students where their voices have been largely hidden in consideration of educational changes. A qualitative approach enables the formulation of a conceptual framework for the implementation of educational change within the context of the country and organization where the study is carried out. It allows for more truthful analysis and conclusions of data collected. It also enables solutions to be recommended that address the actual problems faced in such specific context. The limitation of these approaches, however, is that it is not possible to conduct in-depth investigation of the majority of academics in the university. The present study therefore has a few limitations.
7.4 Implications for Future Research

This study forms one of the earliest attempts at studying teaching staff’s responses to educational change. The findings in this study point to the importance of research in this area, as well as raise a number of issues where more research can be carried out. This section reports, therefore, the constraints in this study, and the implications for further research.

Due to the time constraints, the study was only carried out in one School in the University, though it was the biggest school. In addition only 10% of the academics’ and 5% of the students’ populations were studied. It would have been better if academics from other Schools were interviewed. However, this was not possible because there were time constraints and approval was granted for the research to be conducted in only one school. Therefore, in this study, an in-depth examination of the perspectives, attitudes and beliefs of the academics in one School was carried out, but given more time, the breadth of the study could have been expanded. A more representative sample could then be obtained.

In addition to the sampling, the researcher had to be transparent about her position. Since the present researcher was an academic staff in the School, and the interviews were conducted in the same premises, a few of the interviewees might be inhibited from sharing views that might jeopardize their positions. While certain problems were identified about the implementation of the curriculum change, it was still possible to probe further into the problems encountered by the academics. Perhaps other research methods could also be used that would overcome this problem. One such method is observation. Observation of lectures and tutorials can be carried out for first-hand information of how the academics implement the objectives of the curriculum change in their teaching. In the case of this study, though, it was difficult to get
permission from the academics to observe their classes as this was a sensitive issue. This is, therefore, an area for further research.

In addition, due to the time constraints, this study was conducted over a few months. Consequently, the findings represented the responses of academics and students at a particular time, namely, one year after the change was introduced. Though a year is adequate for academics and students to experience both the benefits and problems of the change, a study over a few years can show how they change and develop in their responses. It will also be possible to examine if the implementation processes are improved. In the case of the present university, the problem with carrying out such a study that spans over a few years is that educational changes are introduced rapidly, one in every year. It is impossible to carry out a study of an educational change over more than one year as it will be replaced by another change.

Subsequently, further studies can be carried out on academics in other schools, and by using other research methods, such as observation. A longitudinal study can also be carried out, if the educational change is allowed to continue for a few years. Alternatively, a longitudinal study can also be done about how much of a particular curriculum change is sustained as well as the effects of frequent educational change on both academics and students. A longitudinal study allows for an examination of development in perception, attitudes and beliefs about educational change as well as the effectiveness of change over a period of time.

In addition, this study has discovered a number of issues and more focused studies can be carried out on each of these. Some of these issues are: how students cope and learn; how academics are involved in teamwork, as well as the factors that influence academics' change in attitudes and beliefs about teaching. Such studies can lead to more in-depth understanding of the issues, and effective implementation of educational change.
Further studies can also be carried out on how other organizational factors, apart from communication and academics' involvement, are important in implementing educational change. These organizational factors include administration, management of resources; and delegation of roles and tasks in implementing a curriculum change. In addition, a qualitative approach is adopted in this study, involving only documentary analysis and interviews. Further research can make use of other methods like action research and observations that will yield authentic data of what actually happens in the implementation of a curriculum change. Research on educational change can help to reduce educational wastage and increase the effectiveness of its implementation. Much more research needs to be done on educational change in Singapore as this is an area that has resulted in substantial stress on educationalists at the management and teaching levels, students and their parents. Therefore, much more consideration needs to be paid to the effectiveness of educational change to examine its effects on students' learning. As a whole, the government needs to realize that for the effects of educational change to be seen, time is required.

7.5 Significance of this Study

This study fills a gap in research on educational change, namely, it provides an in depth examination of teaching staff's perspectives, attitudes and beliefs. It also addresses an important area of consideration in education in Singapore. The findings of this study raise some key issues about educational changes.

This study shows that a gap exists between the plans of policy-makers and teaching staff. The literature on educational change has shown that such a disparity can arise but no research has been identified on how and why this is so. This study has discovered three key factors giving rise to this problem: inappropriate organizational structures; lack of communication and involvement of the academics. These are
significant findings because it is possible to change these factors and improve on the dissemination of the change.

With the government's initiative to grant autonomy to universities, these institutions now can make their decisions regarding recruitment of staff and curricula. This also means that the universities have to consider more seriously how they can help their academic staff and students to adapt to greater flexibility in the curricula and teaching approaches. This autonomy also creates more competition among the educational institutions (Tan, 2003). It is hoped that with this competition, the educational institutions will be forced to provide students with wider choices of courses, improve their programs, thereby improving the quality of education (Tan, 2003). With this increased autonomy, students, staff and academics in the universities have to be very flexible to cope with changes in both organization and the curricula. It is therefore crucial to think about how educational changes can be effectively implemented and how members can be prepared for such changes.

This study has also proven the research literature that asserts the importance of the role of academics in the process of educational change (Chapter Three, p. 26). It shows that where they are not involved adequately both in the planning and dissemination, and communication is inadequate, the implementation of the change is also ineffective. This study shows, however, the process of influencing them to change is complex. It requires time and in the context of Singapore where changes happen rapidly, it results in a great degree of frustration and confusion. No study has been identified in Singapore about the experiences of teaching staff going through such frequent changes and the educational wastage that results. These are, therefore, many areas of study needed in the area of educational change. This study shows how a small nation like Singapore struggles to survive by developing changes in its educational system. It begs the question, however, of how successfully this is done. The findings of this study,
therefore, contribute to research on educational change, in that it shows how a tension arises between national needs and people undergoing educational change.

This study is also significant as no research has been found on the effects of a top-down dissemination of educational change, taking into consideration the political and economic context of the country. This is important as educational changes should be studied in the context of the country and institution in which they occur (Chapter Three, p. 30). In the present world we live in, this is an important area of research as the university is expected to adapt to rapid global changes. This study shows that this situation can have a deep impact on people and make academics' job more challenging. There is literature on the effect of globalization on the university (Chapter Three, p. 30) but there is no identified research on what occurs within the university and the problems that result. The issue of change and its effects on people is complex and this study highlights the need for further study on this.

This study therefore addresses a need to study people's experiences in educational change. Change is seen to have a deep impact on people, particularly in educational change, which affects not just the work of academics, but the lives and future of students. It is hoped that more research in this area can raise the awareness of individuals' experiences, leading to improvement in the planning and dissemination processes of educational change.
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APPENDIX I

INTERVIEW SCHEDULE FOR THE ACADEMICS

I. Organizational Factors

i. Motivation for the Curriculum Change

1. What motivates the University to make the curriculum change?
2. Can you identify a leader or group of people leading the change?
3. How supportive is your team of the change?
4. Would you describe yourself as working as an individual or a team in executing the change?
5. Are you clear about the tasks for the change?
6. Are you clear of the direction of the change?

ii. Institutional Support Given to the Academics

1. Is there a professional development or training program to help you make the changes?
2. Are you aware of the source of the change, or what motivates the change? What is it?
3. Are you aware of the goals of the change? What are they?

iii. Academics’ Collegiality and Collaboration

1. Is there clear and adequate communication between you and the rest of the teaching staff, management staff as well as administrative staff in the initiation, implementation and assessment of the change?
2. How do you communicate? E.g. by email, meetings? How frequently do you communicate?
3. How well do you feel your colleagues and yourself work together in making the change?
4. What problems do you encounter working together?
5. What improvements can be made to the way you all work as a team?
iv. **Changes Made by the Academics to the Curriculum**
1. What kinds of changes are made to the curriculum?
2. What are the changes made to the courses you teach?
3. How do you feel about these changes?

vi. **Changes Made by the Academics to their Teaching**
1. How do you think students respond to the change? Are they supportive of it?
2. Do you think the change benefits students?
3. How does the change enhance students' learning?
4. Do you think the change benefits students' future career?
5. Are parents of students supportive of the change?
6. Do you think employers on the whole and the public are supportive of the change?
7. Do you feel the school climate as a whole is conducive for the change?
APPENDIX II

Interview Schedule for Focus Group Discussion with Students

1. How did you all first hear of these two years common engineering program?

2. Can you remember anything, the lecturers, tutors or Dean, told you anything also the two years common engineering?

3. How would you describe their attitude towards the two years common engineering?

4. What links do you see between the courses that you do, for example, between EEE (Electrical and Electronics Engineering), MPE (Mechanical and Production Engineering), and SME (School of Materials Engineering)?

5. How do you think these two years common engineering affect your learning?

6. What are the goals of these two years common engineering?

7. If you are to recommend some improvements to these two years common engineering program, what would you recommend?
APPENDIX III

References of Academics Interviewed

Table 1 - Distribution of Academics by Position in the School’s Hierarchy

<table>
<thead>
<tr>
<th>Position of Academic Staff</th>
<th>Number</th>
<th>Venue of Interviews</th>
<th>Dates of Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academics Involved in Teaching Only (either Lectures or Tutorials)</td>
<td>AT1, AT2</td>
<td>Interviewees’ Offices</td>
<td>September 2002</td>
</tr>
<tr>
<td></td>
<td>AT3</td>
<td>Interviewees’ Offices</td>
<td>December 2002</td>
</tr>
<tr>
<td></td>
<td>AT4, AT5, AT6, AT7</td>
<td>Interviewees’ Offices</td>
<td>December 2002</td>
</tr>
<tr>
<td>Co-ordinators of Subjects</td>
<td>CO1, CO2</td>
<td>Interviewees’ Offices</td>
<td>September 2002</td>
</tr>
<tr>
<td></td>
<td>CO3</td>
<td>Interviewees’ Offices</td>
<td>December 2002</td>
</tr>
<tr>
<td></td>
<td>CO4</td>
<td>Interviewees’ Offices</td>
<td>December 2002</td>
</tr>
<tr>
<td></td>
<td>CO5, CO6, CO7, CO8</td>
<td>Interviewer’s Office</td>
<td>December 2002</td>
</tr>
<tr>
<td></td>
<td>CO9</td>
<td>Laboratory where interviewee worked</td>
<td>September 2002</td>
</tr>
<tr>
<td></td>
<td>CO10</td>
<td>Canteen</td>
<td>September 2002</td>
</tr>
<tr>
<td>Member of Curriculum Committee</td>
<td>CC</td>
<td>Canteen</td>
<td>September 2002</td>
</tr>
<tr>
<td>Head of Division</td>
<td>HD</td>
<td>Interviewee’s Office</td>
<td>December 2002</td>
</tr>
<tr>
<td>Program Director (at Masters Level)</td>
<td>PD</td>
<td>Interviewee’s Office</td>
<td>December 2002</td>
</tr>
<tr>
<td>Vice-Deans</td>
<td>VD1, VD2</td>
<td>Interviewee’s Office</td>
<td>December 2002</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
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</tr>
</tbody>
</table>
APPENDIX IV

References of Students Involved in Focus Group Discussion

Table 1 - Distribution of Students by Level of Studies

<table>
<thead>
<tr>
<th>Level of Studies</th>
<th>Number</th>
<th>Focus Groups (4-5 students in each group)</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1 Common Engineering</td>
<td>S1</td>
<td>F1 – Focus Group 1</td>
<td>S1F1</td>
</tr>
<tr>
<td></td>
<td>(63 students)</td>
<td>F2 – Focus Group 2</td>
<td>S1F2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F1 – F12</td>
<td>S1F1 – S1F12</td>
</tr>
<tr>
<td>Year 2 Common Engineering</td>
<td>S2</td>
<td>F13 – F21</td>
<td>S2F12 – S2F21</td>
</tr>
<tr>
<td></td>
<td>(40 students)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>103</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*All focus groups discussions took place in the interviewers' office in January 2003.