



Ministry of Education
SINGAPORE

Report of the Committee on the Expansion of the University Sector

Greater Choice, More Room to Excel

Preliminary Report

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Executive Summary

DEVELOPMENTS IN THE UNIVERSITY SECTOR SINCE 2003

1. Singapore's university sector has developed significantly since the Committee to Review the University Sector and Graduate Manpower Planning completed its study in 2003.
2. Our three publicly-funded universities have strengthened their international reputations and established themselves as the cornerstones of our university landscape.
3. The National University of Singapore (NUS) has grown in both size and stature, and currently has an enrolment of more than 23,000 undergraduate and 8,000 postgraduate students.
4. The Nanyang Technological University (NTU) has expanded its disciplinary coverage, establishing three new schools: the School of Humanities and Social Sciences, the School of Physical and Mathematical Sciences, and the School of Art, Design and Media. Its undergraduate enrolment has increased by over 25% to more than 20,000 students, and its number of postgraduate students has grown to 5,400.
5. Since its inception in 2000, the Singapore Management University (SMU) has established a strong reputation among employers, parents and students, providing high-quality undergraduate education through its distinctive seminar-style pedagogy. SMU has broadened the diversity of its undergraduate programmes and started to grow its research capabilities and postgraduate programmes.
6. In 2006, NUS and NTU were corporatised, becoming Autonomous Universities (AUs) similar to SMU. The objective of this was to enable all three AUs to better compete in the global environment, and become world-class institutions.
7. In addition to our three AUs, the Government provides publicly-funded university education through our polytechnics' partnerships with foreign specialised institutions (FSIs) to offer degrees in niche programmes. Recently, the Government has also committed to providing subsidies for part-time degree programmes for Continuing Education and Training (CET) in the AUs and at SIM University (UniSIM).

INCREASED PARTICIPATION IN THE UNIVERSITY SECTOR

8. In his National Day Rally speech on 19 August 2007, Prime Minister Mr Lee Hsien Loong announced that the Government would aim to provide subsidised university education for 30% of each Singaporean cohort by 2015, an increase from the previous target of 25% to be achieved by 2010. In total, this 5%-points increase in cohort participation rate (CPR) will require about 2,400 additional university places to be made available each year. It is likely that out of the overall CPR of 30%, about 21.5%-points and 8.5%-points will come through the junior college and polytechnic routes respectively (compared with 19%-points and 6%-points with a CPR of 25%). This means that approximately 1,200 additional A-level students and 1,200

additional polytechnic graduates will be able to access subsidised university education by 2015. The expanded university sector will have the capacity to cater to a larger number of Singaporeans while continuing to take a healthy proportion of international students.

9. Even as we increase our cohort participation rate, we must match the supply of graduates with the demands of our economy, both in terms of numbers and skills required. We must also not lose sight of the need to maintain the high standards of education and admissions of our publicly-funded universities. This will help us avoid the experience of a number of other countries that have allowed expansions in university intake, at the expense of the quality of their universities and graduate employability.

10. The expanded university sector must help power Singapore's next phase of growth by providing high-quality graduate manpower. It must be able to provide our young people with high levels of knowledge and skills, as well as impart a spirit of innovation and creativity that they will need as Singapore's economy moves up the value chain and into new growth areas.

11. To maintain standards, admissions to the pool of expanded university places should still be based on merit. However, it is envisaged that the expansion will cater to a wider spectrum of students with different backgrounds, abilities, talents and learning approaches. In particular, proportionately more polytechnic students could benefit from a high-quality, publicly-funded university education.

EVOLUTION AND ENHANCEMENT OF EXISTING UNIVERSITIES

12. The Committee consulted NUS, NTU and SMU on their plans to position themselves in Singapore's new university landscape.

13. The Committee supports the aspirations of NUS and NTU to develop into leading, world-class research-intensive universities. Recognising the continued importance of science & technology to the economy, both universities also have plans to establish new engineering programmes. NUS will introduce a Two-Track Engineering Programme to train Specialist-Engineers and Engineer-Leaders, while NTU will introduce an interdisciplinary, exclusive and distinctly branded Premier Engineering Programme leading to a direct Master's degree in Engineering.

14. The Committee also supports SMU's plans for further expansion from its current intake of 1,600 to a steady-state intake of about 2,100 undergraduates in 2015. SMU will maintain its focus on business and management, and expand its disciplinary coverage to include curriculum offerings in new areas such as International Relations/Studies, Risk Analysis & Management and Maritime Business Economics.

A NEW PUBLICLY-FUNDED UNIVERSITY

15. The Committee recommends the establishment of a new publicly-funded university. This new university will aim to provide a differentiated education, increase choice and diversity in the university landscape, and help supply the additional capacity needed to provide more students with a publicly-funded university education. It could cater to an annual intake of about 2,000 – 2,500 students at steady state.

16. The Committee recommends that the new university distinguish itself through an interdisciplinary approach to education. Beyond discipline-specific knowledge and skills, students of the new university will experience inter-disciplinary learning through a variety of means, including coursework and projects.

17. Instead of rigid boundaries around disciplines, the programmes at the new university will be integrated, e.g. classes would be co-taught by faculty from different disciplines, with students working in interdisciplinary project teams. Furthermore, the new university could set up interdisciplinary centres to oversee such programmes and carry out research that is industry-focused and solutions-directed.

18. The Committee recommends that the new university provide its students with extensive real-world experience to better equip them with the knowledge and attributes required to make an immediate impact when they enter the workforce. Students will gain work experience through structured internships and other programmes in collaboration with industry. The new university will also equip all students with entrepreneurship skills to enable them to better grasp opportunities and create value in a fast-changing world.

19. After consultations with industry and government agencies and dialogues with students and parents, the Committee has proposed that the new university could, at the start, offer disciplines in (i) Design and Architecture, (ii) Engineering and Applied Sciences, and (iii) Business and Information Technology. An integrated approach centred around these disciplines will help undergraduates better understand the importance of integrating superior design, sound engineering and a savvy business and marketing plan in the development of new products or services. Further, the Committee envisions that the three disciplinary areas could offer room for the new university to develop interdisciplinary collaboration and learning in areas where Singapore has strengths, such as sustainable design and development and clean technology.

LIBERAL ARTS EDUCATION

20. The Committee feels that further consideration should be given to the introduction of liberal arts education in Singapore. Liberal arts education is characterised by broad-based, multi-disciplinary learning, high-quality teaching and intensive interaction among students and with faculty members. The introduction of liberal arts education will help us offer an intellectually invigorating environment and an additional avenue to develop independent and critical thinkers who can go on to become leaders in the economic, social and political fields.

21. NUS has submitted a proposal to set up a liberal arts college (LAC) in Singapore. While the Committee recognises the benefits that NUS' proposal would bring, it recommends further consideration of specific issues in greater detail. These pertain to the demand for and value ascribed to the LAC by students, their parents and employers. The LAC would also have to compete for bright students who have been used to traditional disciplines that lead to professional degrees. Furthermore, NUS' proposed LAC would need to partner with an established foreign LAC to be better able to attract good students and faculty.

NICHE DEGREE PROGRAMMES OFFERED BY TIE-UPS BETWEEN POLYTECHNICS AND FOREIGN SPECIALISED INSTITUTIONS, AND INDEPENDENT DEGREE-AWARDING INSTITUTIONS

22. The Committee recognises that there could be programmes which are not presently offered as publicly-funded degree programmes in strategic sectors of our economy. For these selected programmes, there is scope to consider public funding to facilitate the provision of graduate manpower.

23. The Committee recommends that more Poly-FSI partnerships be established, expanding beyond the original target of 460 places by 2010 to 700 in the longer term. In addition to Poly-FSIs, the Committee recommends that the Government consider subsidising a limited number of local undergraduate students in selected independent, degree-awarding institutions (IDIs) that are based in Singapore. This could include places within high-quality foreign institutions established in Singapore under the Economic Development Board's (EDB) Global Schoolhouse Initiative.

CONCLUSION

24. The Committee envisions that its recommendations will create a more robust and diverse university sector in Singapore. Students will benefit from an expanded range of options for higher education. Overall, Singapore's publicly-funded university landscape will feature two large universities, NUS and NTU, each offering a comprehensive suite of high-quality undergraduate programmes and a strong focus on postgraduate education and research. There will also be two mid-sized universities, SMU and the new university, each offering a focused selection of degree programmes. Niche areas will also be catered to through our polytechnics in partnership with foreign specialised institutions and through selected high-quality independent degree-awarding institutions in Singapore. Finally, those who missed out on a publicly-funded degree education early on in their lives will be able to pursue subsidised part-time degree-level CET programmes offered through local universities.

25. The Committee is of the view that the new university sector will be well-positioned to meet the needs of the economy, offer high-quality higher education to students and further enhance its international reputation. Although the establishment of new institutions and policy frameworks will be challenging, the Committee believes that these are timely investments that will play an integral part in ensuring that our economy and graduates can thrive in the future globalised world.

Chapter 1 Introduction

- 1.1 As Singapore's economy has grown and evolved, Singapore's publicly-funded university sector has continued to provide a large proportion of the graduate manpower needed to power our industries. It also serves to attract talented international students to study in Singapore, many of whom choose to stay and contribute to our country.
- 1.2 The last five years have seen significant changes in our economy and in the university sector. There is growing demand for highly-skilled graduate manpower as our economy moves increasingly into knowledge-based, high value-added activities such as research and development. At the same time, Singapore faces increasingly fierce competition from other countries for talented students and graduates.
- 1.3 In this light, the Government has invested heavily in our three publicly-funded universities, both to improve their quality, and to provide more publicly-funded university places. The Government's goal of providing 25% of every Primary 1 cohort with a publicly-funded university education by 2010 has been achieved ahead of schedule, in 2008. It was thus timely to review this target, and to consider how best to further develop our university sector for the future.

COMMITTEE ON THE EXPANSION OF THE UNIVERSITY SECTOR

- 1.4 On 19 August 2007, Prime Minister Mr Lee Hsien Loong announced the establishment of a Committee chaired by then-Minister of State for Education, RAdm (NS) Lui Tuck Yew, and advised by Dr Tony Tan, Chairman of the Ministry of Education's (MOE) International Academic Advisory Panel. The Committee was to recommend the best approach to the expansion of the university sector, taking into account the Government's intention to provide subsidised university education for 30% of each Singaporean cohort by 2015 in order to:-
 - a. Provide additional publicly-subsidised university places that are broadly aligned with Singapore's longer-term manpower needs; and
 - b. Allow for a diversity of university-level paths, to meet the needs of the market and the aspirations of parents and students.
- 1.5 The Committee comprised members from the public sector, academia and industry. A list of the Committee members is at Annex A.
- 1.6 The Committee was supported in its work by two working groups – the New University Working Group and the Liberal Arts College Working Group – which were formed to extend the discussions of the Committee and facilitate its work. The members who served in the two Working Groups are at Annex B.

APPROACH TO THE COMMITTEE'S STUDY

- 1.7 The Committee began its work by exploring the university landscapes of developed countries, which have evolved to provide more diversity to support their economies and to cater to a wider range of student interests and abilities. Between September and October 2007, members of the Committee and Working Groups visited countries in Europe and the United States to learn about different university models and systems. Successful features of these well-established systems were distilled as learning points for Singapore's own long-term vision. Learning points from the study trips are at [Annex C](#).
- 1.8 The Committee also sought feedback from key stakeholders, including parents, students and industry leaders, through various channels. These channels included focus group discussions, dialogue sessions with the senior management of the Autonomous Universities and online public discussion forums. A summary of the feedback from stakeholders is at [Annex D](#).
- 1.9 The Committee's preliminary recommendations were announced during the Committee of Supply Debates 2008, where Members of Parliament had the opportunity to discuss the Committee's proposals.

Chapter 2

Singapore's Current University Landscape

- 2.1 The current subsidised university cohort participation rate (CPR) in Singapore is 25% (comprising 19% who are students from pre-university institutions, and 6% who are diploma-holders from polytechnics). This compares with 14% in 1991 and 5% in 1980.

PUBLICLY-FUNDED DEGREE PROGRAMMES

- 2.2 Subsidised university education is currently provided by the three publicly-funded universities in Singapore – National University of Singapore (NUS), Nanyang Technological University (NTU), and Singapore Management University (SMU). In addition, a small number of places are provided through collaborations between our polytechnics and foreign specialised institutions (FSIs) to provide degrees in niche areas.
- 2.3 Both NUS (established in 1980) and NTU (established in 1991) are large universities offering a wide range of undergraduate programmes. SMU (established in 2000) is a small university offering programmes in business and management. Besides undergraduate education, the three universities aim to excel in postgraduate training and research. In April 2006, NUS and NTU were corporatised as not-for-profit companies limited by guarantee to become Autonomous Universities (AUs), similar to SMU.
- 2.4 The Government also provides publicly-funded degree programmes through collaborations between polytechnics and foreign specialised institutions (FSIs). Through Poly-FSI partnerships, polytechnics tap on their capabilities to provide a practice-oriented route of learning at higher levels. These partnerships also provide polytechnic graduates with more opportunities to pursue a university education locally at a lower cost than going overseas. To date, five Poly-FSI tie-ups have been announced. Our polytechnics plan to establish at least 10 Poly-FSI programmes with a total student intake of 460 by AY2010.
- 2.5 Recently, the Government has committed to providing subsidies for adults seeking part-time degree programmes offered through the AUs and SIM University (UniSIM). UniSIM is a private university providing continuing education and upgrading opportunities on a part-time basis for working professionals. Funding for these part-time degree programmes will start in July 2008. This is expected to benefit about 8,000 adult learners each year.

NON-FUNDED DEGREE PROGRAMMES

- 2.6 Outside the sphere of publicly-funded degree programmes, students can also opt for a wide range of undergraduate and postgraduate degree programmes that are not funded by the Government. These include degree programmes offered by high-quality foreign institutions that have established themselves in

Singapore under EDB's Global Schoolhouse initiative, and external degree programmes (EDPs) offered by foreign universities through Private Education Organisations (PEOs).

- 2.7 EDB's Global Schoolhouse initiative aims to attract international students and executives by providing high-quality degree and diploma courses in specialised areas such as business, hotel administration and digital arts. To date, the Chicago Graduate School of Business, ESSEC, INSEAD, the New York University Tisch School of the Arts, and the S P Jain Institute of Management offer postgraduate degree programmes under this initiative, while the University of Nevada, Las Vegas (UNLV) and the Digipen Institute of Technology offer undergraduate degree programmes.¹
- 2.8 Singapore's university sector has served us well thus far. However, the rapidly-changing global economy, the evolving education landscape, the need to provide diverse pathways, and the challenge of attracting and retaining talent make it timely to review the university sector to ensure that it will continue to support our development and meet the needs of our people in future.

¹ The Digipen Institute of Technology will admit its first undergraduate intake in September 2008.

Chapter 3

Producing Graduates for the Future

- 3.1 This chapter establishes the rationale for the review of our university sector within the context of our current economic and social landscapes, and proposes three key strategic thrusts that will drive the enhancement of the university landscape to prepare our graduates for the future.

MEETING THE NEEDS OF THE FUTURE ECONOMY

- 3.2 Singapore's Gross Domestic Product (GDP) is projected to grow at around 5% annually up to 2015. Manufacturing will continue to be a pillar of our economy, driven by growth in industries such as transport engineering, biomedical manufacturing and chemicals. Robust growth is likewise expected in the services sector, both in the more established industries such as financial services, info-communications technology (ICT), maritime, logistics, and media and arts, as well as in the smaller industries, such as private education, design, professional services, and private healthcare. Singapore's R&D capabilities in areas such as environment and water technologies, biomedical sciences, and interactive and digital media, will also be enhanced.
- 3.3 The new economy will be characterised by sophistication and diversification. First, it will continue to shift towards more knowledge-driven and innovation-powered activities. This will require even more highly-skilled workers, at both the graduate and postgraduate levels. Second, the economy will become increasingly dynamic as a result of the interconnectivity of a globalised world and rapid technological advancement. To enhance the resilience and adaptability of our graduates in the labour market, their university education needs to equip them with fundamental competencies required across industries, such as communication and learning skills, in addition to specialised knowledge and skills in key disciplines.
- 3.4 Science and technology (S&T) will continue to play a central role in our economy, particularly in the areas of manufacturing and R&D. Our strengths in S&T will also benefit the services sector, for instance, through the use of ICT in retail, or the application of high-level mathematics in finance. Our university sector should thus continue to develop graduates with technical competencies so that our highly-skilled workforce remains as our competitive edge in propelling economic growth.

GROWING THE EDUCATION LANDSCAPE

- 3.5 Singapore has adopted an approach of growing our university sector in tandem with and meeting the needs of our economy. The Ministry of Education, together with the Ministry of Manpower and the Ministry of Trade and Industry, undertakes an annual manpower planning process which guides the number and distribution of university graduates to be produced by our three autonomous universities (AUs) according to industries' need for

graduate manpower. Mismatches between graduates' training and employment opportunities are minimised, which gives us a better assurance that the graduates from our local universities will be equipped with industry-relevant skill sets and enjoy good employment prospects. In recent years, virtually all economically active graduates were employed within 6 months of graduation. Because we have adopted a gradual and calibrated approach to growing our university sector, we have avoided the situation in a number of other countries where rapid expansion in university intake had led to a spike in graduate unemployment.

- 3.6 Singapore's investment in general and post-secondary education has produced rising educational standards. Our students are increasingly well-prepared and more are able to benefit from a university education. This trend, coupled with the growing sophistication of the Singapore economy, gives us further impetus to grow the university sector while ensuring that we can maintain high standards, quality and employability.
- 3.7 The increase of 5% CPR will mean more opportunities for both polytechnic students and JC students. It is likely that out of the overall target CPR of 30% to be achieved by 2015, about 8.5%-points will come through the polytechnic route and 21.5%-points through the JC route, compared with 6%-points and 19%-points respectively with a CPR of 25%. This means that about 15% more JC students and 40% more polytechnic students will be able to obtain a subsidised university education than is the case today. In absolute terms, approximately 1,200 additional A-level students and 1,200 additional polytechnic graduates will be able to access subsidised university education by 2015. This will help meet growing aspirations for high-quality, affordable university education as more students benefit from a subsidised education at a local university.
- 3.8 This increase in university CPR will be especially helpful to the growing number of high-quality polytechnic students seeking entry to our universities. An increasing number of "O" level students eligible for entry to a Junior College are opting instead to enter our polytechnics to receive a hands-on, practice-oriented education. In 2003, the percentage of JC-eligible "O" level students who opted for the polytechnic route was approximately 25%. In 2008, this number grew to 32%.

PROVIDING DIVERSE PATHWAYS

- 3.9 In recent years, our school sector has become significantly more diverse, providing many different pathways for students of differing abilities, talents and interests. We should also inject a higher degree of diversity in our publicly-funded university sector as it expands.
- 3.10 NUS and NTU, which provide the bulk of publicly-subsidised university places, are both large universities with a comprehensive range of offerings seeking to excel in both teaching and research. SMU offers some diversity with its seminar-style teaching and its focus on business and management. However, there is still much scope to add diversity to our university landscape to cater to

students of different abilities, talents and learning approaches, who are looking for different models of university education to meet their needs.

- 3.11 Moving forward, we should develop a range of institutions with different areas of focus, educational approaches, programme offerings and institutional characters. This will avoid a single measure of quality, and encourage the development of “best-in-class” institutions and many peaks of excellence.

ATTRACTING AND RETAINING TALENT

- 3.12 An enhancement to the university sector, both in the scope of degree-level programmes and the quality of the university experience, will strengthen Singapore’s position as a talent hub, both to retain our own talent and to draw in foreign talent. Currently, a number of our top students choose to further their studies overseas, as overseas institutions offer a wide range of programmes, and renowned faculty. Our students are also attracted to the experience of studying and living overseas in a more collegiate environment, and the opportunity to be immersed in a foreign culture.
- 3.13 Our local institutions should endeavour to retain more of the brightest students in Singapore. Besides providing a more affordable education, our institutions should strive to improve their international standing, attract top faculty, and offer a wider range of programmes, pedagogical approaches, and a more conducive learning and living environment. For students attracted by the experience of studying overseas, our local institutions can provide more opportunities for overseas exposure, including the establishment of more joint degrees with top overseas institutions, and more overseas exchanges and attachments.
- 3.14 Many students who study overseas may also choose to stay and work there when they complete their first degree, as they are attracted by the opportunity to gain working experience with top overseas companies. As Singapore’s economy continues to grow, more multinational companies are establishing global and regional headquarters here. More could be done to provide students in our local institutions with attractive work experience programmes in such companies, both in Singapore and abroad.
- 3.15 At the same time, our university sector should serve to draw talent to Singapore, offering a compelling value proposition to attract more talented international students to seek degree opportunities in Singapore. This will add to the vibrancy in the universities and benefit Singapore’s economy in the long term.
- 3.16 The expansion of the university sector is timely as it will create additional capacity to cater to a larger number of Singaporeans while continuing to take a healthy proportion of international students.

KEY CONSIDERATIONS AND STRATEGIC THRUSTS

3.17 In formulating its recommendations, the Committee has adhered to the following key considerations:-

- a. Close matching of graduate manpower to industry needs. Even as we expand and enhance the university sector, we must be careful to maintain and enhance the current level of graduate employability. The output of graduates and distribution of skill-sets among our graduates should continue to be closely matched to the demands of our economy.
- b. Institutional excellence. An increase in subsidised university CPR must also be underpinned by the high standards of education and admissions of our publicly-funded universities. While the market may, and already does, tier institutions and their programmes, we should set out to create and develop best-of-class institutions. We should also maintain a high standard in the quality of the student body, including A-level and polytechnic graduates, as well as international students. All our institutions should attract their share of bright students, including high-quality international students, in order to uplift the entire university sector.
- c. Multiple diversities. Building on our AUs, we should develop more diversity through a range of institutional models across the university sector. Within institutions, we should also develop different pedagogical approaches. These would cater to a wider pool of students with diverse interests and talents, and ultimately develop a rich variety of university graduates, each with his strengths and passion.
- d. Greater competition to spur excellence. The Government has invested heavily and exclusively in the AUs to build up the quality of the university sector. This has allowed our AUs the opportunity to mature and develop into high-quality institutions, with ample access to good quality students, faculty and resources. Our AUs have made significant progress in establishing themselves both locally and internationally as institutions of excellence. They are a partner of choice for many overseas universities, including top US and European institutions. Our AUs are now ready to face more intense competition locally with the next phase of new institutions and programmes recommended by the Committee. Competition will spur greater innovation and resilience in our university sector as a whole and provide more quality options for students.

3.18 Taking into account the needs and challenges of the future, and the key considerations set out above, the Committee recommends that the university sector be expanded and augmented by (i) **enhancing our existing universities**; and (ii) **establishing new institutions**.

3.19 The following chapters set out the Committee's recommendations that support the strategic thrusts set out above.

Chapter 4

Evolution and Enhancement of the Existing Universities

Key Recommendations

- For NUS to develop as a world-class research-intensive university with enhanced flagship programmes for undergraduate students.
- For NTU to develop as a research-intensive university with a focus on science and technology while enhancing its undergraduate education.
- For SMU to grow into a mid-sized university and expand its disciplinary coverage in areas complementary to its focus on business and management.

- 4.1 The Committee has engaged the Board and leadership of the three Autonomous Universities (AUs) on their plans for the future, in view of the expansion of the university sector.
- 4.2 NUS and NTU have expressed their wish to focus on further improving the quality of their undergraduate programmes, particularly with regard to developing new peaks of excellence in undergraduate education. As research-intensive universities, NUS and NTU will also build stronger postgraduate education and research capabilities.
- 4.3 SMU plans to expand in size and disciplinary coverage, while maintaining its focus on business and management. It will also develop its postgraduate education and research activities.

NATIONAL UNIVERSITY OF SINGAPORE

- 4.4 The Committee supports NUS' aspiration to be a leading world-class research-intensive university which aims to:-
- a. Be the university of choice for the most talented students in Singapore and the wider region;
 - b. Provide highly multi-disciplinary education that nurtures broad-based and thinking graduates with strong leadership and entrepreneurial potential; and
 - c. Place a strong emphasis on graduate education.
- 4.5 To achieve this, NUS will continue to build on the quality and impact of its faculty, research and global programmes, maintaining the strong momentum built over the last 10 years. The University Town project, which is part of NUS' strategic plan to develop new peaks of excellence in its undergraduate and graduate education, will also enable NUS to attract top talent and

enhance its reputation.² The project will be completed in 2010. In addition to the University Town, NUS intends to put in place several key initiatives going forward.

Initiatives to Enhance Undergraduate Education

- 4.6 Two-Track Engineering Programme. The Committee supports NUS' proposal to develop a Two-Track Engineering Programme within the general undergraduate engineering education framework. This programme will aim to train NUS' top engineering students as Specialist-Engineers and Engineer-Leaders. The Specialist-Engineers Track will focus on equipping students with advanced multi-disciplinary scientific knowledge, to enable them to work at the frontiers of engineering and science. The Engineer-Leaders Track will equip students with the fundamentals of Engineering training, enhanced by a curriculum that places emphasis on design, management and systems, and an appreciation of major technological issues facing the world, in particular Asia.
- 4.7 Students on the two-track programme will acquire their foundational skills from either NUS' University Scholars' Programme (USP) or NUS' enhanced Engineering Science Programme. NUS proposes to launch its two-track engineering programme in AY2011 with an initial intake of 100 students.
- 4.8 The University Scholars Programme (USP). The USP has been successful in educating a new generation of student-intellectuals through its in-house programmes and extensive partnership with many honours and special programmes in top universities. Moving forward, this programme will be housed in one of the colleges in the new University Town. NUS hopes to extend the pedagogical style of the "USP core curriculum" to a larger set of modules, so that USP students will obtain up to an additional year of this pedagogical style, carefully integrated into the curriculum of their chosen major or concentration.³
- 4.9 International education. NUS' Overseas Colleges have been successful in providing an innovative experiential education. This programme will be further expanded to more locations, such as Beijing, Europe and emerging markets, in order to help students to gain a better appreciation of the potential in these economies.
- 4.10 In order to enhance its profile in international education, NUS also intends to expand its summer entrepreneurship programme, which currently brings undergraduates from top Chinese universities here to learn more about

² The University Town will comprise five undergraduate residential colleges and two graduate residences, with a total capacity of 5,000 places. The town centre will have educational facilities as well as retail space, where students will have the opportunity to engage in entrepreneurial activities. Incoming international exchange students may be housed at the University Town, thereby providing NUS students with exciting opportunities for networking.

³ USP students currently obtain 30% of their academic credits through the USP curriculum, and 70% from their home faculty. The USP curriculum comprises interdisciplinary modules on topics such as Human Relations, and Ethics and the Environment.

Singapore through lectures and company visits. Going forward, NUS will extend the programme to students from other universities in India, Middle East and ASEAN.

Initiatives to Enhance Postgraduate Education

- 4.11 NUS intends to further improve the quality of its graduate research programmes. NUS also aims to admit better quality graduate students, and to increase its graduate student enrolment, with a more diversified international representation. To achieve this, NUS intends to continue to recruit top-notch faculty members, and enhance the attractiveness of scholarships offered by the university.
- 4.12 NUS also plans to implement new PhD programmes, many exploring new multi-disciplinary research themes and leveraging on the opportunities provided by the Campus for Research Excellence and Technological Enterprise (CREATE), the Research Centres of Excellence, and other research institutes and centres. In addition, NUS plans to locate graduate residences within the University Town to ensure that the growth of graduate enrolment will enrich undergraduate education through greater integration and interaction between graduate and undergraduate students.

NANYANG TECHNOLOGICAL UNIVERSITY

- 4.13 The Committee supports NTU's aim to provide a broad education that also equips graduates with the appropriate specialised skills. NTU hopes to nurture graduates who are problem solvers equipped for the changing nature of the global and Singaporean economy. In the long term, NTU intends to enhance its identity as a comprehensive university while retaining its strong focus on engineering, and the technological and natural sciences.⁴ NTU also intends to develop as an internationally-recognised modern research-intensive university, with an intimate link between research and teaching. NTU proposes to put in place new initiatives to help it achieve its goals.

Initiatives to Enhance Undergraduate Education

- 4.14 Blue Ribbon Commission on Undergraduate Education. The 11-member Blue Ribbon Commission on Undergraduate Education was convened in July 2007 to review NTU's undergraduate programmes. The Commission was chaired by Professor Haresh Shah, Emeritus Professor of Stanford University and member of the NTU Board of Trustees, and comprised both academics and fresh NTU graduates. The Commission completed its review in March 2008. NTU is currently considering the Commission's recommendations, including for NTU to provide a broad-based undergraduate experience, take a greater student-centric approach to learning, and emphasise the residential nature of its university experience.

⁴ Approximately 50% of the undergraduates in NTU are in the College of Engineering.

- 4.15 Premier Engineering Programme. The Committee supports NTU's proposal to establish a Premier Engineering Programme (PEP) that is distinctive from the Two-Track Engineering Programme at NUS. The PEP will enable NTU to:-
- a. Produce top engineers who will go on to become industrial and business leaders, chief technology officers and CEOs of technological companies, as well as leaders in other sectors of the economy and the public sector;
 - b. Create buzz and excitement around engineering, which will encourage a renewed interest in Engineering among the brightest local students; and
 - c. Develop a peak of excellence in Engineering at the undergraduate level. NTU believes that there is strong potential for graduates of such a programme to approach the standards set by MIT, Caltech and Imperial College, who are in great demand by graduate schools and industry.
- 4.16 NTU's PEP will be a four-year accelerated programme leading to a direct Master degree in Engineering. It will be an exclusive programme that is distinct from the mainstream programmes in NTU's College of Engineering. Mentorship and residential learning will be important aspects of this programme. To facilitate this, NTU intends to accommodate all the PEP students together with their mentors, who are the Hall Fellows, in a single Hall of Residence catering exclusively to students of the programme.
- 4.17 NTU also intends to position the PEP as an interdisciplinary programme which provides a broad-based curriculum to develop greater intellectual versatility and curiosity in its students. In addition, NTU will arrange for every PEP student to spend at least one semester in an overseas university or research facility to gain exposure to alternative learning methods and different cultures in world-class institutions. The PEP will also offer research opportunities for all its students, who will be given the opportunity to work closely with globally-recognised names in various fields.
- 4.18 NTU proposes to launch its PEP in AY2009 with an initial intake of 75 - 100 students, and a steady-state intake of 125 students. In parallel with the PEP, NTU will continue to develop its C N Yang programme for top undergraduates, principally in the area of the natural sciences. Together with the PEP, the C N Yang Scholars Programme will provide more options for top students in NTU.

Initiatives to Enhance Postgraduate Education

- 4.19 NTU plans to significantly increase its postgraduate enrolment in order to approach international benchmarks for universities of comparable size and aspirations. This would include increasing the number of Masters by coursework programmes to address industry needs. Current examples of such industry-oriented Masters programmes include NTU's Master of Science in Offshore Engineering, catering to the maritime industry in Singapore, and its Master of Science in Digital Media Technology, which targets the emerging Interactive and Digital Media industry.

- 4.20 NTU also intends to increase its PhD student enrolment significantly to meet the need in R&D and innovation-intensive sectors such as the life sciences and aerospace engineering. NTU has already established collaborative research projects with industry partners such as Rolls-Royce Fuel Cell Systems and Infineon. In addition, NTU aims to develop interdisciplinary graduate schools to provide a distinctive and innovative approach to PhD training.

SINGAPORE MANAGEMENT UNIVERSITY

- 4.21 The Committee supports SMU's intention to maintain (i) its distinctiveness, which is built on its seminar-style pedagogy; (ii) its smaller class sizes, which are highly interactive; (iii) its flexible broad-based and inter-disciplinary education; and (iv) the vibrancy of its city campus.
- 4.22 The Committee also supports SMU's intention to focus on strengthening its research capabilities and developing its range of postgraduate offerings over the next three to five years. In addition, SMU is keen to strengthen and expand its range of core business and complementary disciplines. SMU should be highly selective in defining the areas of growth, which will be driven by strategic alignment with its current offerings.

Expansion Plans

- 4.23 The Committee recommends that SMU be allowed to increase its steady-state undergraduate population moderately in the longer term. SMU proposes to expand its undergraduate intake from the current intake of 1,600 students to achieve a long-term steady-state undergraduate intake of about 2,100 by AY2015. Together with a long-term steady-state postgraduate enrolment target of around 2,000, SMU aims to have a total student (undergraduate and graduate) population of around 10,300 in its long-term steady state.
- 4.24 To cater for this increase, SMU proposes to introduce new majors and new tracks within existing majors in complementary areas, e.g. International Relations/Studies, Risk Analysis & Management and Maritime Business Economics. In the longer term, SMU may also explore the possibility of introducing new degree programmes.
- 4.25 In this respect, SMU may model its expansion after comparable world-class institutions, such as the London School of Economics and Political Science (LSE) in terms of its exclusive focus on social sciences disciplines, or Princeton University in terms of its pedagogical style and broad-based curriculum.

Chapter 5

A New Publicly-Funded University

Key Recommendations

- To establish a new mid-sized, publicly-funded university offering a focused selection of degree programmes.
- To differentiate the new university from the existing universities through an interdisciplinary approach to education, real-world experience, a focus on entrepreneurship and solutions-directed research.
- To explore strategic alliances between the new university and a high-quality university overseas.

RATIONALE FOR ESTABLISHING A NEW UNIVERSITY

- 5.1 The Committee recommends the establishment of a new publicly-funded university to help supply the additional capacity needed to provide more students with a publicly-funded university education.
- 5.2 The earlier target participation rate of 25% had been reached by building on our three Autonomous Universities (AUs). However, it would be difficult to expand NUS and NTU further to reach the new target without the risk of eroding their quality. SMU alone will not be able to provide the number of places required while maintaining its unique pedagogical approach of seminar-style teaching.
- 5.3 Furthermore, our AUs have made good headway in establishing themselves both locally and internationally as high-quality institutions. In particular, SMU has established a strong and credible name for itself within a few years of its establishment. The Committee is of the view that our university sector is now ready for more diversity, built around the core of our established universities, to provide greater choice for our students.
- 5.4 A new university that is independent of the existing universities offers the best chance of creating an institution that has its own unique identity, character and model of education to add real diversity in educational approaches to the benefit of our students. Drawing on the experience of SMU, an independent university that has its own mission and governance and charts its own course and direction can become a differentiated and well-regarded institution within a decade of its establishment.

MODEL FOR A NEW UNIVERSITY

- 5.5 **Mid-sized university offering a focused selection of disciplines.** The Committee recommends that the new university start off by offering a focused selection of disciplines. This will allow it to better maximise its resources, and

will help create a distinctive character. More schools and programmes could be added in future as it moves towards a steady state intake of students. At steady state, the new university could cater to an annual intake of about 2,000 - 2,500 students.

- 5.6 **International collaboration.** The new university could forge a strategic alliance with a high-quality university overseas, at both the institutional and faculty level. This would help the new university leverage on the experience of this partner to develop a world-class curriculum and recruit experienced faculty. Such an alliance will also benefit students of the new university by offering them opportunities for exchange programmes to gain overseas exposure, and by providing some students with the possibility of obtaining joint or double degrees in collaboration with the partner university.

POSSIBLE FEATURES OF A NEW UNIVERSITY

- 5.7 The Committee has considered the future needs of Singapore's economy, consulted widely with industry leaders, parents and students, and looked at various models of university education in the US and Europe. Based on this research and feedback, the Committee proposes the key features for the new university set out below. The Committee believes that these features will give the new university a distinctive character, and position it to produce graduates who are well prepared for the challenges of the future.

Approach to Education and Research

Integrated, Interdisciplinary Approach

- 5.8 The Committee notes that increasingly, jobs in the future will not only require a deep knowledge of a particular specialisation, but also the ability to integrate knowledge across traditional disciplinary lines. To take advantage of opportunities in the future, graduates will need to be able to adopt an integrated approach to knowledge and problem-solving. As such, the Committee recommends that the new university emphasise interdisciplinary learning. This will go beyond learning that is tied to strict disciplinary boundaries, and instead, provide students with a wider perspective as they engage in learning at the intersection of different disciplines.
- 5.9 Many universities currently have interdisciplinary programmes that aim to bridge the divide between faculties. However, pre-existing conditions such as organisational structure and culture, budgeting and manpower allocation sometimes limit the extent of such programmes and how much they can achieve.
- 5.10 The new university will start with the advantage of not having to battle against such legacies, and will be able to design its academic programme to deliver this interdisciplinary approach. This will ensure coherence and integration of programmes and approaches from the start, rather than attempt to bring together disparate elements that were developed separately.

- 5.11 **Interdisciplinary courses.** The courses at the new university could be formulated so that there is significant integration from the outset between areas such as engineering and design or engineering and business. Graduates will have a sound fundamental knowledge of each discipline, but will also recognise and appreciate that some of the most exciting learning will take place with the integration of the traditional disciplines. Such courses ought to be taught by teams that comprise faculty members from various disciplines.
- 5.12 **Interdisciplinary project teams.** The interdisciplinary approach could be augmented by having students work on projects that encourage the synthesis and application of knowledge.⁵ For example, students could be required to complete a final-year capstone project for which they would work in multi-disciplinary project teams to provide solutions to problems sourced from industry.
- 5.13 **Interdisciplinary centres.** To bring greater focus to such interdisciplinary learning and collaboration, the new university could set up interdisciplinary centres focused around specific themes such as future urban environments and sustainable development. These centres could oversee the universities' interdisciplinary programmes and research activities.

Exposure to Real-World Experiences

- 5.14 The Committee sees value in providing students of the new university with greater exposure to knowledge application in a real-world context. While other universities currently provide work experience opportunities for some, the new university could make real-world experience an integral part of its programmes for all its students.
- 5.15 **Industry experience.** Students should be given opportunities to gain industry experience through extended internships, both locally and overseas. This would develop graduates with strong team-work and people skills, and a realistic view of the working world. These internships could be offered on a competitive basis, which would also teach students valuable skills such as how to present themselves effectively in their resumes and in formal interviews. The Committee has consulted industry leaders and they have indicated their support for such internships as they feel that this produces graduates who are more work-ready upon graduation.
- 5.16 The Committee recognises that such internship arrangements will require the investment of resources by the university and industry. For companies that are able to commit to a significant number of internship places over an extended term, the university could designate a staff member to coordinate

⁵ The inclusion of projects as a major component of learning is seen in overseas universities such as Aalborg University and Roskilde University in Denmark, and in Franklin W. Olin College of Engineering and Harvey Mudd College in the US. See [Annex E](#) for more on the use of projects in teaching and learning at Aalborg University.

programmes and identify projects that will offer both the highest educational value to students and the greatest benefit to the company. This could be modelled after the practice school concept, a well-known example of which is the MIT David H. Koch School of Chemical Engineering Practice (US) (see [Annex E](#)).

- 5.17 In addition to sending its students out into industry, the new university could also invite industry into the university. Branch offices and research facilities of key industry partners could be co-located on campus, providing rich opportunities for collaboration and idea-sharing between students, faculty and industry players.
- 5.18 **Entrepreneurship as part of core curriculum.** Including entrepreneurship as part of the core curriculum would equip students with the skills and mindset to discern and seize opportunities, and to turn ideas into new value propositions. For degree programmes such as business studies, entrepreneurship would feature as a key theme underlying the design of the curriculum. The university could also support faculty and student start-ups by providing incubator space, offering guidance on intellectual property management, and facilitating meetings with potential investors. An incubator programme would also serve as a living laboratory for students and faculty to test out ideas generated in class and research within a real-world environment.
- 5.19 To further encourage students to engage in entrepreneurial activities, the new university could explore the feasibility of allowing students to take a year off during the course of their studies to pursue their entrepreneurial interests. Depending on the nature of the activity, students may use their experiences during this time to count towards their course requirements.
- 5.20 **Flexibility in programme and course duration.** The new university could exercise flexibility in structuring courses so that students with relevant prior learning could progress at a faster pace. Polytechnic graduates with relevant diplomas could receive advanced standing and exemptions to certain courses, akin to what they enjoy in some overseas universities. Likewise, the new university could cater to students who need a longer time to complete their degree because they would like to capitalise on the full range of opportunities, e.g. for additional overseas attachments and internships, or students who wish to disrupt their studies to pursue entrepreneurial or sporting interests.
- 5.21 **Solutions-directed research.** In line with its emphasis on the application of knowledge, faculty and students in the new university should concentrate on research that provides practical and effective solutions to problems that industry and companies face in the near and medium term. To anticipate and respond to such needs, the new university should forge and maintain strong links with industry and other sectors of society to actively seek out appropriate research opportunities.

DISCIPLINES TO BE OFFERED BY THE NEW UNIVERSITY

- 5.22 Based on views and feedback gathered from industry, economic agencies and other stakeholders, the Committee recommends that the new university leadership explore a combination of programmes within the following disciplinary areas:-
- a. Design and Architecture;
 - b. Engineering and Applied Sciences; and
 - c. Business and Information Technology.
- 5.23 The Committee envisages that the new university could develop flagship programmes within each disciplinary area that would support the key growth areas for Singapore's economy. The focused range of disciplines will also allow the university to concentrate its resources in its initial years. Other disciplinary areas could be added subsequently as required.
- 5.24 The Committee feels that the proposed disciplinary areas lend themselves well to the new university's emphasis on interdisciplinary learning and real-world application of knowledge. The new university could capitalise on the interplay between each of these disciplines, and develop programmes in interdisciplinary areas such as sustainable design, clean technology and human-computer interaction.
- 5.25 The combination of design, engineering and business also offers a wealth of possibilities for innovation and collaboration with industry, as evidenced by leading institutions overseas such as Stanford University's Hasso Plattner Institute of Design and Carnegie Mellon University.

CAMPUS FOR THE NEW UNIVERSITY

- 5.26 The Committee notes that location and campus environment are two critical factors that contribute to the success of a university and its students' educational experience. The campus should be set in a location that is both easily accessible and attractive. The Committee envisages that the new university will be designed and resourced to support and enhance its chosen approach to education.
- 5.27 The Committee also recommends that the campus incorporate facilities to bring industry into the new university. It should therefore have sufficient growth potential and capacity to accommodate offices, business facilities and research facilities for industry partners in close proximity to students and faculty to encourage collaboration. The campus could also include an incubator centre to provide low-cost space and business facilities for student and faculty start-ups.

FUNDING

- 5.28 The general funding framework for the new university should be modelled after that for the existing AUs. This will enable the new university to be adequately resourced and allow it to offer its students the same standard of quality education as in the other AUs.

IMPLEMENTATION APPROACH FOR THE NEW UNIVERSITY

- 5.29 The Committee recommends that the Ministry of Education appoint a Steering Committee for the establishment of the new university, in order to meet the target participation rate of 30% by 2015.

Chapter 6

Liberal Arts Education in Singapore

Key Recommendation

- That the Government give due consideration to NUS' proposal to set up a Liberal Arts College in partnership with reputable and established foreign institutions.

LIBERAL ARTS EDUCATION

- 6.1 A liberal arts education (LAE) offers a broad-based, multidisciplinary undergraduate programme that may encompass the natural and social sciences, mathematics and humanities. Distinct from producing graduates with professional competence, LAE seeks to develop a passion for inquiry and knowledge, and to develop well-rounded individuals.
- 6.2 The liberal arts tradition is most evident in the US where such programmes exist across a range of institutions. This includes standalone liberal arts colleges (LACs) or universities with a liberal arts orientation, such as Yale University. The quality of students admitted into the top US LACs is comparable to those in Ivy League universities. High-calibre students in the US therefore have the option of enrolling in an LAC, universities with a liberal arts tradition, or discipline-based programmes in universities with strengths in particular disciplines.
- 6.3 LACs are distinguished by a small student intake of 200 - 300 each year. Coupled with a low student-to-faculty ratio and high-quality teaching, LACs allow for intense interaction among students and with faculty to create an intellectually invigorating environment where students are trained to be critical and independent thinkers, and where ideas are freely shared and debated. Because of their low student-to-faculty ratio, LACs in the US typically charge high tuition fees in the region of US\$30,000 to US\$40,000 per year while at the same time providing generous financial aid packages and scholarships for needy students from their sizeable endowments.

VALUE PROPOSITION OF INTRODUCING LAE IN SINGAPORE

- 6.4 The Committee notes that the concept of liberal arts education is still unfamiliar to many in Singapore. However, this awareness is growing, and more Singapore students are opting for a liberal arts education. For instance, the public sector has been awarding scholarships in recent years to a small but growing number of Singaporeans who have chosen to undertake their first degree at either liberal arts colleges or universities with a strong liberal arts tradition.
- 6.5 The Committee has thus studied models of liberal arts education in the US and Europe, and visited several outstanding overseas LACs. The Committee

is of the view that the introduction of liberal arts education in Singapore warrants serious consideration as there would be resulting benefits, as outlined below.

- 6.6 **Add a new peak of excellence in Singapore's university landscape.** An LAC's signature combination of broad-based education, small student population and intense interaction with faculty would add a unique and valuable element to our university sector. Discussions with parents and appropriate student groups have shown that such an offering would appeal to some of our brightest students, especially those who have emerged from schools offering programmes with similar characteristics, e.g. Integrated Programmes or the International Baccalaureate. It could also be attractive to bright students who currently look overseas for a broad-based undergraduate education in LACs or universities in the US. An LAC could thus be an attractive new feature in our university landscape that would attract such students to study in Singapore.
- 6.7 **Provide more pathways to develop thinkers and leaders.** A high proportion of graduates from US LACs go on to pursue professional or graduate studies. Many go on to make their mark in society across diverse fields. This may be attributed to the ability of LACs to inculcate a love of learning in their students, spurring them on to pursue their areas of interest after graduation. A local LAC could, over time, instil this same love of learning in our bright students, encouraging more to pursue postgraduate studies. In addition, with its emphasis on critical, independent thought, an LAC is also well-positioned to develop well-rounded leaders who are versatile enough to be successful at the highest levels across many different domains in a rapidly changing world. A local LAC could thus be a crucible to educate the future leaders of Singapore and the region.
- 6.8 **Enhance Singapore's reputation as an Education Hub.** Liberal arts education is relatively new to the region, and there are no renowned LACs in Asia. Singapore, with its ability to bridge East and West, is uniquely positioned to establish an LAC modelled after the US Colleges, but that is also distinctively Asian. Establishing a top-quality LAC in Singapore will provide an innovative educational offering in the region that would contribute to Singapore's position as being on the cutting edge of higher education. This would draw more bright students from the region and beyond to study here. With clear pathways for such students to pursue their postgraduate or professional degrees in Singapore, a Singapore LAC could contribute to having more talented international students sink roots here in the long term.

NUS' PROPOSAL

- 6.9 To gauge the feasibility of establishing a liberal arts institution in Singapore, NUS was invited to submit a proposal in November 2007. Some of the main features of NUS' proposed LAC are:-
 - a. An educational philosophy similar to its US counterparts, which emphasises broadness of perspective, critical thinking, reasoning,

communication and quantitative skills as characteristics of an educated individual.

- b. A curriculum that focuses on the arts and humanities, social sciences and natural sciences. The LAC will offer a range of majors leading to either a Bachelor of Arts or a Bachelor of Science. In addition, NUS will explore the possibility for LAC students to take up integrated degrees with its professional schools, e.g. a five-year programme where students spend two and a half years obtaining a liberal arts education, and two and a half years in the Law School or the Engineering School, graduating with two degrees. NUS also intends to allow LAC students to cross-register for certain courses in the main university.
- c. A residential college experience in NUS' University Town project at Warren-Medway. This will allow the LAC to leverage on the ecosystem of the various institutions located within the University Town, such as the Asia Research Institute (ARI) and the Campus for Research Excellence and Technological Enterprise (CREATE). Students would be able to interact with leading international researchers and experts from these institutions through seminars, internships and courses. They would also have opportunities to participate in cutting-edge research projects and interdisciplinary studies conducted at these institutions.

RECOMMENDATION

- 6.10 The Committee is of the view that benefits would be derived from introducing liberal arts education in Singapore. Nevertheless, whether this type of education would be valued by students, their parents and employers needs to be taken in to account. As a new concept, LAE would have to compete for bright students who have been used to traditional routes of professional degrees. Even those who subscribe to LAE may prefer to attend a well-established LAC in the US. In view of these uncertainties, the Committee recommends that further issues be considered:-
- 6.11 **Partnership with top foreign LAC.** To increase the likelihood of acceptance by students, public and industry, the proposed LAC should forge a partnership with a well-established foreign LAC. This would enable our LAC to tap on the expertise and faculty of the partner institution to quickly establish high-quality programmes in the LAC. In addition, it would serve to import the unique culture of learning and interaction characteristic of such top foreign LACs into the new institution. Such a partnership would also leverage on the brand name of the reputable foreign partner to help the new LAC gain mindshare in Singapore, enabling it to attract good-quality students and faculty.
- 6.12 **Student intake.** The LAC requires students with academic aptitude, who are able to benefit from the rigorous broad-based education it will offer. In established LACs, the quality of the students itself is a key factor in the learning process. The Committee recommends therefore that MOE explore the optimal mix of local and international students in the LAC, given that a more diverse mix of students would lend rich and varied perspectives to the

discussions in the LAC. This study should also keep in mind the need to ensure an appropriate distribution of bright students across the various faculties in our Autonomous Universities (AUs).

- 6.13 **Institutional model.** The Committee notes that most well-known US LACs are independent, stand-alone institutions. These are governed by their own Boards of Trustees (BOTs) and have autonomy over their finances and policies, e.g. admissions and programme structure.
- 6.14 Alternatively, an LAC could be established as an affiliate to one of our existing AUs, while retaining its autonomy and unique character. An affiliated LAC often leverages on some of the resources of its “parent” institution, e.g. faculty and administrative staff, and infrastructure like laboratories and libraries. An example of such an LAC is Barnard College, which is affiliated to Columbia University.
- 6.15 While an LAC that is closely affiliated to its parent university may be constrained by having to conform to the wider policies set by its parent institution, the Committee feels that these concerns can be addressed by adopting an appropriate governance structure. The Committee notes that the AUs have experience in successfully managing autonomous institutions, e.g. the Yong Siew Toh Conservatory of Music and the Duke-NUS Graduate Medical School at NUS, and the S. Rajaratnam School of International Studies (RSIS) at NTU.
- 6.16 **Funding model.** The Committee notes that independent LACs such as those in the US are generally privately funded, with large endowment funds in the region of up to US\$1 million per student. Examples include top American LACs such as Amherst College and Williams College. Even if the LAC were set up as an affiliate of an existing university, it would be significantly more costly than funding a typical programme in our AUs.
- 6.17 The Committee recommends that MOE study possible funding models for the LAC. In particular, the Committee is of the view that building up an endowment fund would be helpful in sustaining the LAC even if it adopted an affiliated model.

Chapter 7

Niche Degree Programmes

Key Recommendations

- To expand the niche degree programmes offered through tie-ups between Polytechnics and Specialised Institutions.
- To consider funding a limited number of local students enrolled in selected niche undergraduate degree programmes at independent degree-awarding institutions in Singapore.

EXPANDING THE SELECTION OF PUBLICLY-SUBSIDISED DEGREE PROGRAMMES

- 7.1 Apart from the degree programmes offered by the Autonomous Universities (AUs), Singapore's university sector also includes a range of both publicly-funded and non-publicly-funded niche degree programmes that are offered by other institutions.
- 7.2 In terms of publicly-funded niche degree programmes, polytechnic students can opt for a small number of niche degree programmes offered by polytechnics in collaboration with foreign universities under the existing polytechnic-foreign specialised institution (Poly-FSI) framework.
- 7.3 Non-publicly-funded degree programmes are offered by independent, degree-awarding institutions (IDIs). These are high-quality foreign institutions brought in by the Economic Development Board (EDB) under its Global Schoolhouse Initiative.⁶
- 7.4 To facilitate the provision of graduate manpower in programmes that are not presently offered at the degree-level by our publicly-funded universities, but where a strong demand exists in strategic sectors of our economy, the Committee proposes that:-
- a. The Government continue to support our polytechnics to establish more collaborations with foreign specialised institutions and offer degrees in more niche areas; and
 - b. The Government consider funding a limited number of students taking up niche degree programmes in high-quality IDIs. Such funding should be restricted to programmes that support Singapore's manpower needs and overall economic strategies.

⁶ An independent degree awarding institution is an institution that does not have Singapore university status but awards degrees in its own name in Singapore. Currently, seven IDIs have established themselves in Singapore under EDB's Global Schoolhouse Initiative. Five offer postgraduate programmes, namely the Chicago Graduate School of Business, ESSEC, INSEAD, the New York University Tisch School of the Arts, and the S P Jain Institute of Management. Only the University of Nevada (Las Vegas) and the Digipen Institute of Technology offer undergraduate degrees. The Digipen Institute of Technology will admit its first undergraduate intake in September 2008.

- 7.5 **Increase choices for our students.** Both measures will create a wider selection of good-quality, affordable degree programmes that cater to the interests of diverse groups of students. In particular, expanding the number of degree programmes offered under the Poly-FSI framework will give polytechnic graduates more opportunities to upgrade their qualifications in their affirmed area of ability and interest in Singapore.
- 7.6 **Provide a more flexible way of supporting economic needs and graduate manpower demands.** Funding for these two initiatives can be adjusted in line with economic needs. This will provide the Government with greater flexibility in the provision of subsidised university places at the undergraduate level and allow the existing universities to moderate their undergraduate intake accordingly.

POLY-FSI PROGRAMMES

- 7.7 Since 2007, five degree programmes have been launched under the Poly-FSI framework. These programmes provide places to more than 200 students every year to pursue degree education in fields like Early Childhood Education, Retail Management, Naval Architecture, Food Technology and Creative Producing. Our polytechnics plan to establish at least 10 Poly-FSI programmes with an estimated annual student intake of 460 by AY2010.
- 7.8 Going forward, the Committee recommends that the Ministry of Education continue to encourage our polytechnics to establish more of such partnerships. With the introduction of new diploma programmes, there is further scope to expand the Poly-FSI initiative to include collaborations with more reputed overseas universities. Over time, this could cater to about 700 students per year.

INDEPENDENT DEGREE-AWARDING INSTITUTIONS

- 7.9 The Committee recommends that the Ministry of Education work with relevant agencies on the feasibility and details of funding for IDIs, including identifying key niche areas, as well as the level and scope of funding.

Chapter 8

Conclusion

- 8.1 The Government's commitment to increase the subsidised university cohort participation rate from 25% to 30% provides the opportunity to position the university sector for its next stage of development. The Committee believes that the recommendations set out in this Report will allow the university sector to continue to provide skilled manpower for the economy, nurture the talents of our young people, and develop even greater quality going forward, contributing to making Singapore the education hub for the region.
- 8.2 The Committee envisions that Singapore's publicly-funded university sector could comprise the following elements in the long term:-
- a. Two large comprehensive universities, NUS and NTU, each with a total undergraduate and graduate student enrolment of approximately 30,000;
 - b. Two focused mid-sized universities, SMU and the new publicly-funded university, each with a total undergraduate and graduate student enrolment of 10,000 - 12,000;
 - c. A Liberal Arts College (LAC) offering a broad-based undergraduate education to bright students from Singapore and the region;
 - d. Polytechnic-Foreign Specialised Institution (Poly-FSI) partnerships and Independent, Degree-awarding Institutions (IDIs) offering niche degree programmes;
 - e. A range of postgraduate programmes offered through the AUs; and
 - f. Publicly-subsidised Continuing Education and Training (CET) programmes offered through the AUs and SIM University (UniSIM).
- 8.3 The Committee is encouraged by the enthusiasm that various stakeholders have shown for the proposed direction for the overall university landscape. Government agencies and industry representatives have provided valuable feedback on the needs of the economy going forward, and have committed to being partners in this next phase of development. The Committee is also grateful to students, parents and the general public who have contributed many useful insights and comments that have helped shape the recommendations contained in this Report.
- 8.4 The three Autonomous Universities have responded decisively to the opportunities presented by the new target participation rate. NUS, NTU and SMU have made strategic decisions regarding their priorities and directions, and have further defined the character of their institutions. They have also committed to bold new initiatives that will help them continue to develop as world-class universities, and reach even further heights of excellence.

- 8.5 The Committee's recommendations include several new initiatives that will position Singapore's university sector well for the future. These include the new university, the Liberal Arts College, and public funding for a specific number of local students to attend high-quality foreign institutions in Singapore. The Committee is confident that these initiatives, built around the established core of our three Autonomous Universities, will develop into distinctive and high-quality features of our university sector going forward.

Annex A
List of Committee Members

COMPOSITION OF THE STEERING COMMITTEE ON THE EXPANSION OF THE UNIVERSITY SECTOR

Advisor: Dr Tony Tan	
Chairman: RAdm (NS) Lui Tuck Yew, Senior Minister of State for Education	
Members:	
<u>Public Sector</u>	
Mrs Tan Ching Yee	Permanent Secretary Ministry of Education
Mr Leo Yip	Permanent Secretary Ministry of Manpower
Mr Peter Ong	Permanent Secretary Ministry of Trade & Industry
Mr Ko Kheng Hwa	Managing Director Economic Development Board
<u>Private Sector/Academia</u>	
Mr Wong Ngit Liong	Chairman & CEO Venture Corporation Ltd (Chairman, NUS Board of Trustees)
Mr Koh Boon Hwee	Chairman DBS Group Holdings (Chairman, NTU Board of Trustees)
Mr Ho Kwon Ping	Executive Chairman, Banyan Tree Holdings Ltd (Chairman, SMU Board of Trustees)
Prof Bertil Andersson	Provost Nanyang Technological University
Prof Cham Tao Soon	Chairman & Chancellor SIM University
Mr Kwa Chong Seng	Chairman and Managing Director ExxonMobil Asia Pacific Pte Ltd
Dr Liu Thai Ker	Director RSP Architects Planners & Engineers

Annex B List of Working Group Members

Composition of the New University Working Group

Chairman			
1.	Mrs Tan Ching Yee	Permanent Secretary	Ministry of Education
Members			
2.	Ms Chang Hwee Nee	Deputy Secretary (Policy)	Ministry of Education
3.	Mr Aubeck Kam	Deputy Secretary	Ministry of Manpower
4.	Ms Aw Kah Peng	Assistant Managing Director, Economic Development Board	Economic Agencies/Statutory Boards
5.	Mr Soh Kong Pheng	Chief Executive, DSTA	
6.	Ms Yena Lim	Managing Director, A*STAR	
7.	Mr Chia Mia Chiang	Principal, Ngee Ann Polytechnic	Institution of Higher Learning
8.	Prof Low Teck Seng	Principal, Republic Polytechnic	
9.	Dr Simon See	Director, Sun Microsystems	Private Sector
10.	Mr Tan Kay Yong	Vice President India and China Sourcing & Supply Global Manufacturing & Supply GlaxoSmithKline PLC	

Composition of the Liberal Arts College Working Group

Chairman			
1.	Mrs Tan Ching Yee	Permanent Secretary	Ministry of Education
Advisor			
2.	Mr Leonard Baker	Member, International Academic Advisory Panel MD, Sutter Hill Ventures	
Members			
3.	Miss Seah Jiak Choo	Director-General for Education	Ministry of Education
4.	Ms Chang Hwee Nee	Deputy Secretary (Policy)	
5.	Ms Aw Kah Peng	Assistant Managing Director, Economic Development Board	Economic Agency
6.	Prof Lily Kong	Vice-President (University & Global Relations), National University of Singapore	Institution of Higher Learning
Resource Persons			
7.	Dr Lily Chan	CEO, NUS Enterprise	Institution of Higher Learning
8.	Prof Patrick Casey	Senior Vice Dean, Research, Duke-NUS Graduate Medical School	

Annex C

Learning Points from Study Trips

1. The first phase of the Committee's work, from September to October 2007, consisted of study trips to Europe and the United States to explore possible institutional models. Some institutions seen by the delegation during the study trips include the Delft University of Technology in the Netherlands, the University of Applied Sciences of Eastern Switzerland, the Cooper Union for the Advancement of Science and Art (or Cooper Union), the Northeastern University and the Franklin W. Olin College of Engineering (or Olin College) in the United States. The delegation also visited several liberal arts colleges in the United States, including Amherst, Harvey Mudd, Pomona and Swarthmore College.

2. In general, the delegation observed that the higher education systems in Europe and the United States are more diverse compared to Singapore's. This diversity enables these countries to cater to the different needs and interests of their people.

SUMMARY OF LEARNING POINTS

Strengths in Institutional Landscape

Catering to the needs of a diverse student profile

3. The Netherlands, Switzerland and Finland have all adopted a "binary system" for their higher education sectors, comprising traditional research universities and universities of applied sciences (UASs). In the Netherlands and Finland, for every student who is admitted to a traditional research university, approximately two students are admitted to UASs. UASs cater to both academically and vocationally trained students. However, in the Netherlands and Switzerland, in particular, the binary system builds on the student profiles created by the distinct academic and vocational streams in the school system. Swiss UASs view the two groups of students as bringing different strengths to the institutions. Academically-trained students excel at report-writing and languages, while vocationally-trained students are better at practical and laboratory work. Some UASs offer bridging courses for both groups of students.

4. The US university landscape is characterised by a rich diversity of degree-level options offered by institutions of different characters and foci. Each state has a mixture of (a) doctorate-granting research universities, (b) Master's-level colleges and universities, (c) baccalaureate colleges⁷, (d) associate colleges, and (e) special focus institutions with a high concentration of degrees in a set of related fields such as science and engineering, or business and management. There is also a range of

⁷ Research universities award at least 20 doctoral degrees a year, excluding degrees required for professional practice. Master's colleges and universities generally include institutions that award at least 50 Master's degrees and fewer than 20 doctoral degrees per year. Baccalaureate colleges are institutions where baccalaureate degrees represent at least 10% of the undergraduate degrees, and they award fewer than 50 Master's degrees or 20 doctoral degrees per year. [Based on definition by The Carnegie Foundation for the Advancement of Teaching]

institutions, from those adopting a vocational approach towards education, to those encouraging “education for education’s sake”.

Strong links with industry

5. UASs usually have a high proportion of faculty members who possess industry and professional experience. The Swiss UASs stressed that the majority (up to 90%) of its faculty members had between 15 to 20 years of industry experience, and that this was important in helping the institutions establish strong connections with industry for research and development (R&D)-related work. In Finland, it is a prerequisite for individuals to possess a minimum amount of work experience (e.g. three years) before they can be employed as faculty members at a UAS. In general, UASs tend to supplement their full-time faculty with part-time staff from industry. Similarly in the US, Cooper Union recruits adjunct faculty from the industry in order to bring the latest industry developments into the classrooms.

6. Northeastern University in the US has a strong co-operative programme (“co-op”) which is a distinctive feature of the university. Students can take part in 6-month-long internships with a wide range of companies up to three times during their undergraduate study. In addition to providing students with the opportunity to apply their classroom learning to the workplace, internships also hone the students’ communication and interpersonal skills, and help them make informed choices regarding their career pathways. It is also common for UASs in the Netherlands and Finland to specify a mandatory six-month local or overseas internship or work placement for their students. UASs may assess their students’ performance using the company’s feedback.

7. It is compulsory for students in the European UASs to engage in industry-linked project work. This is often completed in connection with the writing of a Bachelor thesis, the topic of which is provided by the company, and which takes six months for Dutch and Finnish UAS students, and two months for Swiss students to complete. Alternatively, students may engage in multidisciplinary projects, e.g. the engineering and healthcare students of Hogeschool Utrecht are working with a hospital, Phillips and the Netherlands Organisation for Applied Scientific Research (TNO) to design a new hospital.

8. UASs may work with industry to provide training facilities for its own students as well, since it is to both parties’ advantage to produce skilled employees in certain niche areas. Industry feedback is important to both UASs in Europe, and the US universities.

Interdisciplinary/Innovative approach to education

9. Since Swiss UASs comprise a few specialised member institutes, these institutes sometimes work together to develop products, e.g. HSR Hochschule für Technik Rapperswil has worked together with the business students of FHS St. Gallen, a school within the same UAS – the UAS of Eastern Switzerland – on a business plan for a motion sensor and landslide alarm project. Finnish UASs do the

same, bringing their engineers and designers from separate departments together to work on product development.

10. Olin College in the US was started with the mission of preparing future leaders through an innovative engineering education that bridges science and technology, enterprise and society. The college takes on a different approach towards engineering education. For instance, students engage in design engineering work very early in the course, and learn key concepts and theories across different levels of difficulty as they use them to solve real-world engineering problems.

Strong applied research and development (R&D) focus

11. The UASs in Finland, the Netherlands and Switzerland have been given the mandate to engage in applied (or “solution-directed”) research. The distinction between applied and fundamental research lies in the focus of the former on the social or industrial application of concepts that have already been discovered, as opposed to the discovery of new concepts. Examples of applied research include research in pharmaceutical science and bioprocessor technology. UASs in all three countries also link their applied R&D closely with the needs of the region in which they are situated, e.g. a Swiss cantonal authority may commission a UAS to undertake a project to deal with flooding in the region. Although the “professional, economical and confidential” nature of their work renders it necessarily low-profile, UASs’ research output may be measured in terms of the patents they produce and the income generated.

12. The UASs in the Netherlands and Switzerland have strong links with small and medium enterprises (SMEs) where applied R&D is concerned. In contrast, traditional research universities work with multinational companies (MNCs) or research foundations. SMEs also provide research funding to UASs in the Netherlands and Switzerland.

Nurturing entrepreneurship in students

13. Babson College in the US, which is renowned for excellence in entrepreneurship education, has a flagship programme entitled Foundations of Management and Entrepreneurship (FME), which is a year-long immersion into the world of business for first-world students, who would be given a loan of up to US\$3,000 by the college to start a business. The business would be liquidated at the end of one year, and any profits made would be donated to a community service project. The FME is conducted based on a “just-in-time” learning model so that students can apply concepts learnt in the classroom to real business situations as they develop their business plan. Babson also collaborates with other institutions like Olin College on programmes to strengthen the business and entrepreneurial skills of the latter’s engineering students.

Features of Liberal Arts Colleges

Focus on undergraduate teaching

14. Liberal Arts Colleges (LACs) do not offer graduate programmes. Faculty and resources are focused on undergraduate teaching and learning. This focus provides students with many opportunities not available to undergraduates in a larger comprehensive university. For example, undergraduate students in an LAC have the opportunity to participate in high-level research that would only be available to postgraduate students in a comprehensive university.

Developing critical thinking and love for learning

15. Students acquire a good foundation in Natural Sciences, Mathematics, Humanities and Social Sciences through a broad-based education. They are encouraged to think critically and to synthesise knowledge. This is further reinforced through the low student-to-faculty ratio. The close interactions between students and their professors on and off-campus in a small college environment instils in students a love for learning and knowledge.

16. Students are also given time and space to decide on their area of specialisation. They are often able to design their own courses if these are lacking in the LAC's offerings. With this nurturing and grounding, a high proportion of LAC graduates proceed to top graduate schools to pursue medical and law postgraduate degrees.

Networks and collaborations

17. Due to their small enrolments, LACs collaborate with other institutions to share physical as well as academic resources. Potential partners include other LACs as well as larger universities. One example of such a network of partners is the Claremont Consortium, of which Pomona College and Harvey Mudd College are members. Each member in the Consortium has its own Board, management and finances, and over time would develop its own unique character and strengths. For example, Harvey Mudd College specialises in science and engineering, Pomona College focuses more on broad-based education, while Claremont McKenna College focuses on business and management courses. The close proximity of the member institutions enables cross-registration of courses by students across the member institutions. This arrangement also allows students to experience learning in their own small college setting, while living amongst a larger community of students. The extent of collaboration across different Consortiums varies. For example, the member institutions of the Five College Consortium (of which Amherst College is a member) mainly share library resources.

18. LACs also forge joint degree programmes with larger universities. For example, Williams College offers joint degree programmes with Columbia University, offering students the option to graduate within five years, with two bachelor degrees – one in liberal arts and one in another discipline, such as engineering.

Annex D

Summary of Feedback from Stakeholders

1. During the course of the Committee's deliberations, feedback was obtained through various channels:
 - a. Focus group discussions (FGDs) with representatives from industry, industry captains, polytechnic students and staff, JC students, and parents of JC and polytechnic students;
 - b. Meetings with the Presidents and deans of NUS, NTU and SMU;
 - c. Meetings with the Board of Trustees of NUS, NTU and SMU;
 - d. Meetings with other Government agencies;
 - e. Online feedback forums on www.reach.gov.sg through the Ministry of Community Development, Youth and Sports;
 - f. Dialogue session with the Government Parliamentary Committee for Education; and
 - g. 2008 Committee of Supply debate.

SUMMARY OF FINDINGS

Features of New Publicly-Funded University

Admission Criteria

2. Members of the public expressed the hope that polytechnic students could be granted exemption from the first and perhaps second years of the four-year programme at the new university, similar to how polytechnic students currently manage to gain such exemptions at overseas universities. The polytechnic alumni who participated in the FGD emphasised the benefits of such exemptions, since they were able to enter the workforce earlier.

3. There was general agreement that there was value in retaining our polytechnics' identity as diploma-awarding institutions that contribute work-ready graduates to the economy. Some suggested building on the hands-on training offered at polytechnic-level, at the new university.

Discipline Offerings

4. Online respondents as well as FGD participants have stressed that in order to succeed, the new university had to differentiate itself from the three existing universities. One of the ways in which this can be achieved is through the provision of courses that are "widely sought after but rarely found". Some online respondents

suggested that the new university could offer degrees relating to the healthcare or information technology sectors.

5. Industry expressed the hope that the new university could contribute to the number of versatile, articulate graduates in the economy. Industry captains were keen to provide more internship places for university students, as they saw this as a form of pre-employment training that was also to their own benefit.

Partnerships

6. Some suggested forming “strategic tie-ups” with foreign universities in order to jumpstart the reputation of, and the programmes at the new university.

Value Proposition of a Liberal Arts College in Singapore

7. Many Singaporeans misunderstand the concept of a Liberal Arts College (LAC). Often, they mistake an LAC to be an institution that offers only the Humanities, or even Fine and Performing Art degrees only. A few individuals who have studied in US LACs have attempted to clarify this misunderstanding on online forums. They believe that there is value in introducing a broad-based model of education that offers a wide range of disciplines from the Sciences to the Arts, and “education for education’s sake”. However, these individuals also acknowledged that increasing the mindshare of liberal arts education among Singaporeans would be a major challenge.

8. There was concern that a liberal arts education could not fulfil the practical considerations of many Singaporean parents and students, and allow students to obtain financially viable jobs. There were mixed views on whether liberal arts students would nonetheless graduate with soft skills that were desirable to potential employers, or whether specialised knowledge would still be crucial in the new economy. Some members of the public suggested adding an optional practical component, e.g. a specialist diploma, to the liberal arts degree programme in order to make it more appealing to students and parents.

9. Some expressed the view that Singapore was not politically mature enough to accommodate the viewpoints of LAC faculty and students, which might sometimes be radical. Others pointed out that Singapore needed to move away from its examination-oriented approach towards education before an LAC could succeed here.

Evolution of the Existing Universities

10. NUS and NTU stressed the importance of maintaining a favourable student-faculty ratio in order to enhance the overall quality of teaching. Both institutions emphasised that student-faculty ratio was an important consideration within some well-regarded university ranking systems, e.g. the Times Higher Education Supplement.

11. The three Autonomous Universities have highlighted the fact that international competition for high-quality faculty is intense. The cost of recruiting such faculty is correspondingly high.

Funding of Independent Degree-Awarding Institutions

12. The Economic Development Board (EDB) welcomed the proposal to fund independent degree-awarding institutions as a “policy breakthrough” on the part of the Ministry of Education (MOE). EDB and MOE agreed that not all the foreign institutions that had established themselves under the Global Schoolhouse initiative would be eligible for public funding.

Annex E

Examples of Close University-Industry Linkages

PRACTICE SCHOOL - THE MIT DAVID KOCH SCHOOL OF CHEMICAL ENGINEERING PRACTICE

1. Introduction. Established in 1916 to provide practical training in an industrial environment that would supplement classroom studies, the Practice School, at the MIT David Koch School of Chemical Engineering Practice, is essentially an intensive 15-18 month graduate degree program which combines the graduate curriculum in Chemical Engineering at MIT, with three to four one-month projects in host companies around the world.

2. The Practice School Experience. After completing two semesters of coursework at MIT, students on the Master of Science Chemical Engineering Practice programme attend Practice School Stations at host company sites. Each class of six to ten students spend two months at one station before moving on to a different station for another two months. At each station, teams of two or three students work on month-long projects under the guidance of a resident MIT faculty. During the course of each project, the student teams are required to prepare three formal talks, a short scope of work, and a final report documenting the work.

3. Projects. Project topics are posed by the host company which also provides students with the resources required to complete the project. Project sponsors provide student teams specific tasks with defined objectives. The team will receive continuous feedback from both the project sponsor and the MIT team leader to ensure that tasks are successfully completed. These projects may span a wide array of topics, even within a single company. For example, students may be asked to solve an operating problem in the plant, to identify production limitations in a process or to make a preliminary design and cost estimate for a new process. The projects may involve developing a new engineering method for a specific task and students may be required to do laboratory work, survey technical literature, develop math models, analyze production data, deploy a variety of computational tools, question plant operators or review plant procedures – work that is typically done by a chemical engineer.

4. Organisation of the Practice School Station. Permanent stations have MIT Station Directors resident within the company. Station Directors are familiar with the company culture, its staff, facilities, and procedures, and can be of direct help in organising and executing projects in connection with current operations and research. Directors choose problems for group projects that have the highest educational value, provide the broadest exposure to modern technology, and can yield useful results within the time allotted. Apart from practice school stations within the US, the MIT Practice School also has locations in other countries such as the UK and Japan.

PROJECT-BASED TEACHING – AALBORG UNIVERSITY

5. Aalborg University, established in 1974, differentiates itself from older Danish universities with its focus on interdisciplinary, inter-faculty studies; an experimental curriculum based on an interdisciplinary basic course with subsequent specialisation;

and a pedagogical structure based on problem-centred, real-life projects of educational and research relevance.

6. Aalborg University is the central point of the learning process. It is through working with concrete problems of the projects that students learn the methods and theories of their chosen discipline and to apply them.

7. The curriculum is project-organised from the day the freshmen arrive until their graduation:-

- i. In the first year, students are introduced to the concept of project-organised studies.
- ii. In the second and third years, projects are mainly design-oriented. These deal with practical problems in constructing and designing on the basis of a synthesis of knowledge from many disciplines. Here, where students deal with “know-how” problems that can be solved by theories and knowledge acquired in their lectures.

At the graduate level (fourth and fifth years), students engage in problem-oriented projects that deal with the solution of theoretical problems through the use of any relevant knowledge, whatever discipline the knowledge derives from.

8. In order to provide for the use of project work as a basic educational element, the curriculum is organised in general subjects or "themes" and normally cover one semester. For example, in the electrical engineering programme, themes may include Electrical Machines and Power Systems, Communication Technology, Robust Communication, etc. At the start of the semester the theme in question is presented during key lectures and general discussions. Recent projects written during previous semesters may be presented for inspiration, and the students will be encouraged to discuss potential subjects for the project work according to their professional interests.

9. The duration of each project is one semester. 50% of curriculum hours is spent on project work, 25% to courses related to the project and 25% to courses related to the curriculum. Project-related courses are organised in accordance with the general theme for a given semester. The courses may for example, introduce the methods or theories to be used in the project. Together with the project work, the courses are meant to provide a thorough insight in the subject matter. The other type of course is the study unit course, which provides students with the fundamental knowledge of their chosen field and ensures the breadth of their education.

Success of Project-Based Learning at Aalborg University

10. The engineering education in Aalborg has been evaluated and compared with traditional engineering education offered by other Danish universities. This was done by two international panels, as well as by external examiners, graduate engineers and their employers as well as undergraduate and graduate students.

11. The evaluation found that there were no differences in quality between engineers graduated from Aalborg University and the other Danish university offering engineering education in Copenhagen.

12. But the evaluation also found significant differences between the profiles of the graduates from the two Danish engineering universities:-

- i. The engineers from Aalborg were assessed to be stronger in problem-solving, communication, co-operation and general technical knowledge; and
- ii. The traditional engineers were assessed to be stronger in specific technical knowledge and methodology.

13. Overall, the Aalborg engineering programme was assessed to be complementary to the traditional engineering programmes, serving slightly different needs for students and industry.

Reference

Finn Kjersdam, Stig Enemark; *The Aalborg Experiment, Project Innovation in University Education*, Aalborg University Press