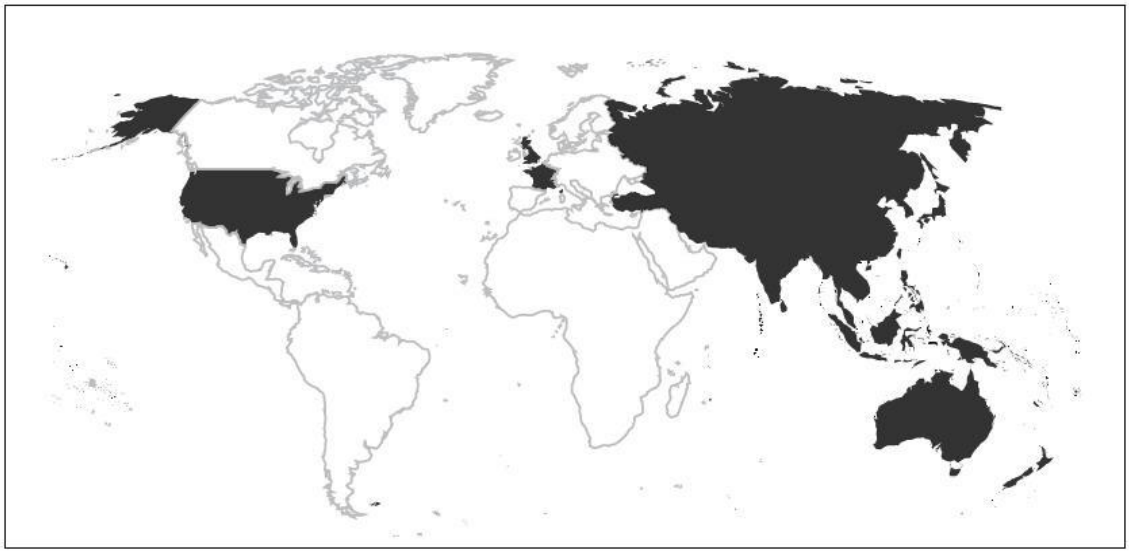
Planning processes, policies and initiatives in ICTD education at institutions of higher learning in Asia and the Pacific:

Thailand Country Paper

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

The secretariat of the Economic and Social Commission for Asia and the Pacific (ESCAP) is the regional development arm of the United Nations and serves as the main economic and social development centre for the United Nations in Asia and the Pacific. Its mandate is to foster cooperation among its 53 members and 9 associate members. It provides the strategic link between global and country-level programmes and issues. It supports Governments of countries in the region in consolidating regional positions and advocates regional approaches to meeting the region's unique socioeconomic challenges in a globalizing world. The ESCAP secretariat is in Bangkok. Please visit the ESCAP website at www.unescap.org for further information.



The shaded areas of the map indicate ESCAP members and associate members.

Acknowledgements

The present paper was prepared by Sujata Gamage of LIRNEasia with substantive contributions from Atsuko Okuda, Dongjong Lee, Siope Vakataki Ofa, Alexey Kravchenko, Shaina Hasan, Jonas Flake, Jeremy Marand, Momar Mbengue and research assistance from Tarnkamon Chantarawat and Sakollerd Limkriangkrai of the Information and Communications Technology and Development Section (IDS) under the guidance of Tiziana Bonapace, Director, Information and Communications Technology and Disaster Risk Reduction Division (IDD) of ESCAP. The paper also benefited from comments received from Sayuri Cocco Okada of the Gender Equality and Social Inclusion Section, Social Development Division of ESCAP, Nuankae Wongthawatchai of the United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) and Jonghwi Park of the United Nations Educational, Scientific and Cultural Organization (UNESCO).

Correspondence concerning this paper should be addressed to the e-mail: escap-ids@un.org.

Contact:
ICT and Development Section
Information and Communications Technology and Disaster Risk Reduction Division
United Nations Economic and Social Commission for Asia and the Pacific
United Nations Building
Rajadamnern Nok Avenue
Bangkok 10200, Thailand
E-mail: escap-ids@un.org

Table of Contents

Abbreviations and Acronyms

APCICT	Asian and Pacific Training Centre for Information and Communication Technology for Development (United Nations)
ASEAN	Association of Southeast Asian Nations
CS	Computer Science
CS&E	Computer Science and Engineering
ESCAP	Economic and Social Commission for Asia and the Pacific (United Nations)
Gbps	Gigabits per Second
I-HUB	Innovation Hub
ICT	Information and Communications Technology
ICTD	Information and Communications Technology for Development
IHL	Institution of Higher Learning
IT	Information Technology
ITU	International Telecommunication Union
LMS	Learning Management System
Mbps	Megabits per Second
NEdNet	National Education Network
NREN	National Research and Education Network
OHEC	Office of the Higher Education Commission
SMS	Student Management System
SARUA	South African Regional Universities Association
STEM	Science, Technology, Engineering and Mathematics
UNESCO	United Nations Educational, Scientific and Cultural Organization
USA	United States of America

1. Introduction

This paper aims to provide a national-level gender-sensitive analysis of information and communications technology for development (ICTD) education in institutions of higher learning (IHLs) in Thailand. The study analyses the planning processes, policies and initiatives in IHLs to prepare future ICTD leaders in the country. It includes an examination of information and communications technology (ICT) connectivity issues, and exploration of the partnerships between IHLs, policymakers, regulators and the private sector.

ICT holds the promise of improving the lives of people, and of disadvantaged people in particular. IHLs in developing countries, especially the public institutions, are continually reminded that they should prepare future leaders with the advanced knowledge and skills needed for the next stage of development in their countries, with the specific aim to achieve the Sustainable Development Goals.

The need for an orientation towards ICTD in academic curricula, whether in ICT or other disciplines, is recognized by the United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) in its Turning Today's Youth into Tomorrow's Leaders' Programme, as pointed out in the following:[1]

> Recent research has indicated that universities and other higher-learning institutions in the region responsible for training the next generation of leaders lack adequate coverage of ICTD in their curricula. Programmes and courses that are best suited to provide training and impart knowledge about the use of ICT for socioeconomic development either do not cover ICTD or [do not] address it in a manner that sufficiently identifies the potential of ICTD.

Does Thailand have plans, policies and initiatives necessary to build tomorrow's ICT leaders with sensitivity to ICTD issues, at the national, institutional and programme levels? This country study attempts to answer this question through desk research, and a case study of a selected academic institution, which includes an in-depth study of its ICT programme. In Thailand, Department of Computer Engineering, Faculty of Engineering at the Chulalongkorn University has been selected for the case study.

An ICTD leader must be able to leverage the potential of ICT for development purposes. For the most part, this requires ICT competencies, although in some cases, business, public policy or domain expertise may suffice. The ICTD practice also requires working in remote, peripheral locations and with vulnerable people. ICT connectivity is likely to be problematic in such areas and for such people. IHLs that prepare ICT or ICTD leaders will be hindered if they lack good ICT connectivity and awareness on the conditions and requirements to implement ICTD initiatives. Therefore, it is necessary to examine the state of ICT connectivity at national, institutional and programme levels. It is hoped that the findings will then feed into the process of policymaking and programming at the IHLs, as well as at the national level, to encourage students and researchers to develop, implement and innovate ICTD initiatives for inclusive and sustainable development.

[1] APCICT, "Turning Today's Youth into Tomorrow's Leaders Programme". Available from http://www.unapcict.org/partners/aboutus/programmes/advisory/future-ict-leaders-programme.

Additionally, analysis with gender dimensions is important because the low participation of women in computing is a worldwide phenomenon. For women to become ICTD leaders, IHLs should have a sufficient number of female graduates in ICT to start with and encourage their active participation in ICTD initiatives.

The study begins by defining ICTD in the context of this study.

1.1 Definitions of ICTD

There is no standard definition of ICTD, but three commonly-referenced sources—APCICT, Heeks and the World Bank[2]—provide sufficient guidance for compiling a definition. APCICT introduces ICTD broadly as the use of ICT to achieve socioeconomic development goals. Heeks who is reputed to have coined the term ICTD, uses ICT in the context of addressing pressing problems of the poor in developing countries. The 2012 World Bank Group Strategy includes the use of ICT to reduce poverty, increase productivity, boost economic growth, and improve accountability and governance. The following definition captures ICTD attributes highlighted in all three sources:

> ICTD is the use of ICT for inclusive and sustainable socioeconomic development.

Preliminary discussion with ICT educators at IHLs reveals that "ICTD" and "inclusive and sustainable socioeconomic development" are difficult concepts for educators and students to grasp, and it is necessary to elaborate on these concepts. Issue 1 of the APCICT Primer Series on ICTD for Youth[3] provides a set of case studies on ICT applications in different sectors and cross-cutting issues, including agriculture, climate change, cultural preservation, education, health, governance, poverty reduction, and the empowerment of marginalized groups. Based on these case studies, the following definition has been found to be useful in explaining ICTD to ICT faculty, students and alumni:

> ICTD is the use of ICT to address problems of a public interest nature that may not be addressed by the private sector without subsidies or other inducements. Examples include ICT applications that bring quality education to marginalized communities, the dissemination of agricultural information to rural communities, and the analysis of big data to better understand and manage public health issues, such as the spread of diseases.

---

[2] APCICT, *Primer Series on ICTD for Youth – Issue 1: An Introduction to ICT for Development* (Incheon, 2013). Available from http://www.unapcict.org/pr; Richard Heeks, "The ICTD 2.0 Manifesto: Where Next for ICTs and International Development?" Development Informatics Working Paper, No. 42 (Manchester: University of Manchester Global Development Institute, 2009). Available from http://www.gdi.manchester.ac.uk/research/publications/other-working-papers/di/di-wp42/; and World Bank, *ICT for Greater Development Impact: World Bank Group Strategy for Information and Communication Technology, 2012-2015* (Washington D.C.: World Bank, 2012). Available from https://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/WBG_ICT_Strategy-2012.pdf.

[3] APCICT, *Primer Series on ICTD for Youth – Issue 1: An Introduction to ICT for Development* (Incheon, 2013). Available from http://www.unapcict.org/pr.

1.2 ICT/ICTD in Higher Learning

Higher education policies and initiatives in a country are generally determined and implemented at three levels:

1. The Ministry of Education or Ministry of Higher Education;
2. The agency that liaises between IHLs and the ministry (e.g., a University Grants Commission); and
3. The accreditation authority

Typically, national policies are set by the Ministry of Education. The formulation and implementation of national and sector-specific policies are carried out by the relevant agencies. A separate accreditation agency may be given the responsibility to maintain standards.

IHLs generally operate with greater autonomy than other educational institutions offering primary, secondary, technical and vocational education.[4] This may be because IHLs are at the top of the credentialing hierarchy in a country, and are therefore expected to self-regulate through peer review and related mechanisms. As a result, IHLs usually formulate and implement policies on their own within the broad guidelines set by the relevant ministry or the responsible agency.

As ICT policies are equally relevant to the objectives of this study, the policies for both higher education and ICT in Thailand are examined.

1.3 ICT Connectivity

If IHLs are to produce future ICT or ICTD leaders, they need data and information on ICT connectivity and usage in teaching and learning processes, and related administration, for decision-making. While country data on general ICT connectivity are available from the International Telecommunication Union (ITU), there are no international surveys conducted on ICT issues in IHLs.

A study by the United Nations Educational, Scientific and Cultural Organization (UNESCO) identifies four critical issues related to the use of ICT in higher education as follows:[5]

1. Better access at lower costs
2. Access through mobile technology
3. Cloud computing
4. Open resources or digital content

However, country-level analyses are missing in the UNESCO study. Similarly, an Asian Development Bank study[6] discusses ICT strategies for universities, but national-level data are

[4] Arthur L. Stinchcombe, *Information and Organizations* (Berkeley: University of California Press, 1990).
[5] UNESCO, *ICTs for Higher Education: Case Studies from Asia and the Pacific* (Bangkok, 2011). Available from http://unesdoc.unesco.org/images/0021/002141/214143E.pdf.
[6] Jouko Sarvi and Hitendra Pillay, *Integrated Information and Communication Technology Strategies for Competitive Higher Education in Asia and the Pacific* (Mandaluyong City: Asian Development Bank, 2015). Available from https://www.adb.org/publications/integrated-ict-strategies-competitive-higher-education.

not provided in the report. Based on a literature review, only reports from the South African Regional Universities Association (SARUA) have been found to provide details on ICT connectivity at an institutional level. The 2006 SARUA study on ICT connectivity at IHLs reports on results from 54 institutions in 27 African countries.[7] SARUA summarizes the state of Internet connectivity at IHLs in Africa as too little, too expensive and poorly managed.

To provide an overview of ICT connectivity at IHLs in Thailand, the study looks at the national ICT policies and initiatives, and the national-level indicators relevant to ICT connectivity. Since institutional-level data on ICT connectivity at IHLs are not available in Thailand, the study examines in detail the ICT connectivity at Chulalongkorn University, a premier public IHL in the country with possibly the best connectivity in a public IHL in Thailand.

1.4 Gender Issues in ICT Education

This paper aims to integrate a gender perspective. The low participation of women in computer science and engineering programmes is a worldwide phenomenon.[8] Comprehensive data on science, technology, engineering and mathematics (STEM) related fields are not available for Thailand but data from a survey of seven countries conducted on women in STEM[9] can be used as a guide.

From the survey, the participation of women in STEM degree programmes from Cambodia, Republic of Korea and United States of America (USA), is estimated at 11 per cent, 19.5 per cent and 20 per cent, respectively.[10] It may be inferred that women's participation in computer science is also in these ranges. The reason for the low participation of women in STEM and computer science across the world is not understood too well. Social conditioning is thought to play a large role.[11] When women's participation in ICT education is small, their participation in ICTD may be assumed to be miniscule. Yet, women could be more enthusiastic about development-oriented applications than men. For instance, it is found that women entrepreneurs are more socially committed, irrespective of their businesses in developed or developing economies. Women are 1.17 times more likely than men to create social ventures rather than economic ventures, and 1.23 times more likely to pursue environmental ventures than economic ventures.[12]

A few studies on Thailand, however, have shown that gender gaps in STEM-related fields are narrowing. According to the Programme for International Student Assessment in 2012, girls outscored boys in mathematics and science subjects in Thai schools.[13] Furthermore, data on

[7] SARUA, "African Tertiary Institutions Connectivity Survey Report", 2006.
[8] Wachira Kigotho, "Women enrol in sciences but not STEM", *University World News*, 20 February 2015. Available from http://www.universityworldnews.com/article.php?story=20150218131443779; and UNESCO, *A Complex Formula: Girls and Women in Science, Technology, Engineering and Mathematics in Asia* (Bangkok, 2015). Available from http://unesdoc.unesco.org/images/0023/002315/231519e.pdf.
[9] National Science Foundation, "Women, Minorities and Persons with Disabilities in Science and Engineering". Available from https://www.nsf.gov/statistics/2015/nsf15311/digest/theme2.cfm.
[10] Ibid.
[11] Eric S. Roberts, Marina Kassianidou and Lilly Irani, "Encouraging Women in Computer Science", Department of Computer Science, Stanford University (no date). Available from http://www-cs.stanford.edu/people/eroberts/papers/SIGCSE-Inroads/EncouragingWomenInCS.pdf.
[12] APCICT, *Women and ICT Frontier Initiative: Enabling Role of ICT for Women Entrepreneurs (Core Content, Module 2)* (Incheon, 2016). Available from http://www.unapcict.org/wifi.
[13] UNESCO, *A Complex Formula: Girls and Women in Science, Technology, Engineering and Mathematics in Asia* (Bangkok, 2015). Available from http://unesdoc.unesco.org/images/0023/002315/231519e.pdf.

researchers in science, technology and innovation in 2009 showed that Thailand had one of the highest proportions of female researchers (51 per cent)[14] among countries in Asia.

In Thailand, the higher female participation in STEM-related fields can be partially attributed to government programmes, in particular, the Development and Promotion of Science and Technology Talents Project initiated in 1984.[15] The project encouraged talented students, particularly girls, to take up science subjects. This initiative has been credited with generating greater interest in science education among girls and catalyzing similar initiatives, such as scholarships to study science and mathematics.

The present study will focus specifically on women's participation in ICT programmes in Thai IHLs.

2. Methodology

This country paper is part of a five-country study of ICTD education at IHLs in Asia and the Pacific. The other countries that the study covers include Cambodia, India, Republic of Korea and Sri Lanka. These countries have been selected based on the following criteria: (1) there must be at least one country from each of the major sub-regions—South Asia, South-East Asia and East Asia; and (2) there must be at least one country from each of the World Bank Lending Groups–high income, upper-middle income, lower-middle income and low income.

The focus of the country paper is on "building ICTD leaders with higher skills", and emphasis is placed on analysing the academic programmes that provide graduates with advanced skills in ICT at the bachelor's level, with some information collected on master's and doctoral degree programmes. Given the paucity of data on ICT or ICTD education at IHLs in general, the focus is on uncovering as many good practices as possible from a well-established ICT degree programme in one selected institution in each country, as identified by the Times Higher Education Ranking Survey[16] or by local recognition. The five selected ICT degree programmes are the top programmes from each of the five surveyed countries. Together, they offer a set of observations on good practices that may be used as reference points, and a basis for ICT and education policymakers to enhance the quality and relevance of policies and programmes in the coming years.

To select an academic programme for this study, the 2016 Times Higher Education Ranking of best universities in the world was used as a guide. Times has ranked Chulalongkorn University in the 151-160 range among Asian universities. Although Mahidol University, King Mongkut's University of Technology, Thonburi University and Chiang Mai University were ranked higher, Chulalongkorn University was selected because it is a public university like the other case study institutions selected for the study.

[14] Ibid.
[15] Asia-Pacific Economic Cooperation, "Gender Equity in Mathematics Education", September 2010. Available from http://publications.apec.org/publication-detail.php?pub_id=1069; and UNESCO, *A Complex Formula: Girls and Women in Science, Technology, Engineering and Mathematics in Asia* (Bangkok, 2015). Available from http://unesdoc.unesco.org/images/0023/002315/231519e.pdf.
[16] Times Higher Education, *The World University Rankings* (2016). Available from http://digital.timeshighereducation.com/THEREPRANKINGS2016/offline/download.pdf.

In this study, the national-level data on ICT connectivity at IHLs are limited to: (1) ICT policies, frameworks and initiatives; (2) ICT connectivity in general; (3) the national research and education networks (NRENs); (4) open educational resources in the country; and (5) the situation and experience in the selected institution and ICT programme.

Related to ICTD education, information on national and institutional policies and initiatives, and general programme characteristics such as data on student enrolment, student-teacher ratios, uses of ICT in education, and innovations in ICT and ICTD education, have been documented.

Data on the percentage of women among the student body and the faculty have also been collected. Informants have been asked to report on any special initiatives to increase the participation of women, and provide country-specific reasons for low women's participation in ICT and ICTD. As a rule of thumb, participation is considered low if it is less than 33 per cent.

From an analysis of all the data and information, a set of challenges and opportunities to foster ICTD leaders in Thailand is presented. It is hoped that the examples and experiences documented in this paper will be used by ICT and education policymakers to strengthen the linkage between the ICT academic programmes, faculty and graduates, and the society at large.

3. ICT Connectivity

In 2015, Thailand won an award for the use of ICTs in sustainable development. The citation to that award posted on the ITU website sums up the current state of ICT in Thailand:[17]

> In 1995, Thailand launched an ambitious technology project to address the goal of ensuring access to education for all citizens. By the early 2000s, Thailand's SchoolNet programme achieved 100 per cent Internet connectivity for schools in the country. In 2002, a comprehensive policy framework for ICT development—the National ICT Master Plan—was created, serving as a blueprint for sustainable growth in the ICT sector. The Master Plan proposed seven principal strategies to be achieved by 2006, and called for the establishment of the Ministry of Information and Communication Technology. Since these policies were enacted, the Kingdom of Thailand has seen remarkable developments in the ICT sector. The wireless market expanded tremendously by 2013, with mobile-cellular penetration reaching over 138 per cent and broadband penetration reaching 52 per cent. Thailand is making strong progress in household ICT accessibility and development as well. Since 2008, computers have replaced telephones as the most commonly available ICT device in Thai homes. In 2014, an expansive new policy framework was introduced: Smart Thailand 2020. The principal objective of the new plan is to boost accessibility, making ICTs a basic commodity for the entire country through ongoing improvements in infrastructure and increased mobile broadband penetration. Additionally, Thailand is constructing technology

[17] ITU, "ICTs in Sustainable Development Awards 2015: Thailand". Available from http://www.itu.int/en/ict-sdg-award/2015/Pages/thailand.aspx.

centres to provide access to ICTs in rural areas with a focus on digital literacy. Thus far, Smart Thailand has resulted in the establishment of some 400,000 public Wi-Fi access points. These developments are expected to continue as Thailand becomes a leader in ICT development in the ASEAN (Association of Southeast Asian Nations) sector.

3.1 National Policies

The ICT Policy Framework 2011-2020 was approved by the Cabinet in March 2011.[18] The vision of ICT 2020 is to use ICT as a key driving force to lead the Thai people towards knowledge and wisdom, and equality and a sustainable economy.

The policy deploys seven development strategies, as follows:

1. Universal and secure ICT and broadband infrastructure
2. ICT human resources and ICT competent workforce
3. ICT industry competitiveness and ASEAN integration
4. Smart government (ICT for government service innovation and good governance)
5. Smart agriculture and smart services (ICT for competitiveness and vibrant economy)
6. Social equality (Smart health and smart learning)
7. Smart environment (ICT for green economic and social development)

In addition to this comprehensive policy framework, Thailand has a National Broadband Policy that captures the government's commitment to universal and secure ICT and broadband infrastructure. The National Broadband Policy aims to develop the broadband network to provide access to at least 80 per cent of the population by 2015, and at least 95 per cent by 2020, ensuring standard quality of service and reasonable service fee.[19] According to the ITU indicators presented in Table 1, Thailand's mobile broadband subscription per capita has reached 79 per cent, approaching the government's targets.

A policy framework requires an implementation authority. In September 2016, the Thai Government announced the establishment of a new Ministry of Digital Economy and Society to replace the Ministry of Information and Communication Technology, which was established in 2002. How the new structure will affect the strategic direction of the ICT Policy Framework is yet to be seen.

Among the current ICT initiatives,[20] the one relevant to higher education is the National Education Network (NEdNET), which includes UniNET—a network connecting universities. NEdNet and UniNet are discussed below.

[18] Thailand's Ministry of Digital Economy and Society, "Thailand Information and Communication Technology Policy Framework (2011-2020): ICT2020", May 2011. Available from http://www.mict.go.th/assets/portals/10/files/e-Publication/Executive%20Summary%20ICT2020.pdf.

[19] Thailand's Ministry of Digital Economy and Society, "National Broadband Policy", 2015. Available from http://www.mict.go.th/assets/portals/10/files/e-Publication/Broadband_ENG_edit.pdf; and Thailand's Ministry of Digital Economy and Society, "Thailand Broadband Policy and Progress", presentation made at the ITU Regional Forum on Reshaping Policy and Regulatory Landscape for Accelerating Broadband Access, Jakarta, Indonesia, 8-10 September 2015. Available from https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2015/Sep-WABA/Presentations/TH-NBB-20150910.pdf.

[20] Current ICT initiatives include: Public Free Wi-Fi (set up of 150,000 Wi-Fi access points in the country); ICT Telecentre & USO NET; Broadband Access in Unprofitable Areas with Universal Service Obligation Fund; Wi-Fi Network for School Education; National Education Network (NEdNet); and Government Information Network.

3.2 ICT Connectivity Indicators

Thailand's Internet access indicators improved markedly from 2013 to 2015, according to ITU's ICT connectivity data:[21]

- The proportion of individuals using the Internet increased from 29 per cent in 2013 to 39 per cent in 2015.
- Fixed-broadband subscriptions increased from 7.8 per cent to 9.2 per cent.
- Mobile-broadband subscriptions increased significantly from 52.3 per cent to 75.3 per cent.
- Internet access at home saw a significant increase from 22.7 per cent to 52.2 per cent.
- Proportion of households with a computer increased marginally from 28.7 per cent to 29.5 per cent.
- Mobile-cellular subscriptions increased marginally from 140 per cent to 154 per cent.
- Fixed-telephone subscriptions decreased from 9.0 per cent to 7.9 per cent.

Table 1: ICT and related indicators in the five case-study countries

	Cambodia	India	Sri Lanka	Thailand	Republic of Korea
GDP per capita, 2015 (current USD)	1,159	1,582	3,926	5,816	27,222
Fixed-telephone subscriptions per 100 inhabitants	1.6	2.0	12.0	7.9	58.1
Fixed (wired) broadband subscriptions per 100 inhabitants	0.5	1.3	3.1	9.2	40.2
Mobile-cellular subscriptions per 100 inhabitants	133.0	78.8	112.8	125.8	118.5
Mobile-broadband subscriptions per 100 inhabitants	42.8	9.4	15.8	75.3	109.7
Households with a computer (%)	16.0	20.0	24.2	29.5	77.1
Households with Internet access at home (%)	21.0	14.1	18.1	52.2	98.8
Individuals using the Internet (%)	19.0	26.0	30.0	39.3	89.9

[21] ITU, "Statistics". Available from http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx.

Sources: ITU, “Statistics”. Available from http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx; and World Bank, "GDP per capita (current US$)". Available from http://data.worldbank.org/indicator/NY.GDP.PCAP.CD?page=3.

A comparison of 2015 ICT connectivity data across all five surveyed countries is of interest here. Values of all indicators increase from Cambodia to India, Sri Lanka, Thailand and Republic of Korea in that order, except for mobile-cellular subscriptions, mobile-broadband subscriptions and households with Internet access. In Cambodia, these three indicators are higher than those reported for India and Sri Lanka, which have higher GDP per capita than Cambodia.

3.3 National Research and Education Networks

NREN is a specialized Internet service provider dedicated to supporting the needs of the research and education communities within a country.[22] Building such networks for research and education is a priority in many countries. NRENs are expected to serve as platforms for collaborative research and education efforts by IHLs in a country.

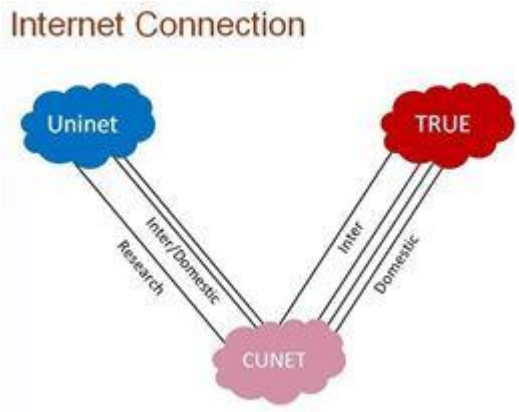
UniNet is an NREN that links universities in Thailand. It is part of NEdNet, which is the network for all education/training/research institutions and libraries. NEdNet focuses on network development for education and research by providing network connectivity to every office, school and educational institute under the Ministry of Education. NEdNet consists of an optical fibre backbone to universities at 1-2 Gbps, to schools at 10-100 Mbps, and to public libraries at 10-100 Mbps per institution.

3.4 Connectivity at IHLs

ChulaNet is the Chulalongkorn University local area network. Currently, ChulaNet is connected to the Internet through TRUE, a private provider. If a student travels to another university in Thailand, he/she can use UniNet. It is provided free of charge by the Office of the Higher Education Commission. Unlike in Sri Lanka or India, ChulaNet does not depend on Thailand’s NREN—UniNet to access the Internet.[23]

[22] For more information about NREN, see TERENA, "Research and Education Networking FAQ". Available from https://www.terena.org/activities/development-support/r+e-faq.
[23] Chulalongkorn University, “Chulalongkorn University Network Diagram”, 20 October 2000. Available from https://www.it.chula.ac.th/sites/default/files/file/20001020-network-map.pdf.

Figure 1: Network diagram at the Chulalongkorn University



At Chulalongkorn University, the Department of Computer Engineering connects to the Faculty of Engineering with a 1 Gbps link, which connects to ChulaNet with a 2 Gbps link. ChulaNet is overseen by the university's Information Technology (IT) office. The university has a 6 Gbps link that connects ChulaNet to TRUE, a commercial network. ChulaNet is also connected to UniNet. The university has a 1 Gbps dedicated line for research that connects to other universities through the Asia Pacific Advanced Network.[24] The department does not subscribe to any private providers—it is a university policy that departments use the university network, which may connect to private providers such as TRUE. The university has invested heavily in its internal network. Two years ago, there was an initiative to get private telecom companies to provide ground floor Wi-Fi across the university campus, with almost 2,000 access points. The Wi-Fi hotspots are incorporated within ChulaNet.

3.5 Integration of ICT in Education

A good test of ICT connectivity at an IHL is the extent to which ICT is integrated within administrative or management systems, student management systems (SMS) and learning management systems (LMS). Below is a summary of how the university uses ICT for various management functions.

3.5.1 Student Management Systems

Student registration for full-time students is carried out online (excluding exchange students). Once registered, students can add and drop classes, as well as access course grades.

3.5.2 Learning Management Systems

There are three LMS endorsed by the university:

- Blackboard

[24] The Asia Pacific Advanced Network refers to both the organization representing its members and to the backbone network that connects the research and education networks of its member countries/economies of Asia and the Pacific. See https://apan.net/member/thairen for more details.

- Moodle
- CourseVille

Courseville was developed by the Faculty of Engineering at the Chulalongkorn University. It integrates with Facebook, and many features have been added to the LMS to support active learning.

About 60-70 per cent of the faculty use one or more LMS—with about two-thirds using Blackboard, and the rest using CourseVille. Only one faculty member uses Moodle. Blackboard is most widely used as it is the first platform introduced at the faculty, but CourseVille is catching up because it is more student friendly. CourseVille also integrates well with other systems, such as the Curriculum and Course Information System that is used to manage the programme curricula throughout the university, and submit data to the SMS and the Ministry of Education. This diversity of systems demonstrates that the faculty is allowed to innovate and experiment with different systems.

4. ICTD Planning, Policies and Initiatives

4.1 National Level

The Office of the Higher Education Commission (OHEC) under the Ministry of Education is responsible for managing higher education provision and promoting higher education development on the basis of academic freedom and excellence. The OHEC has seven bureaus under it, each with about five objectives of a generic nature.[25]

This broad-based approach to policy formulation is a good practice as it gives IHLs the freedom to develop their own planning, polices and initiatives within the broad national development, equity and access guidelines of the government.

4.2 Institutional Level

At the institutional level, Chulalongkorn University's vision and mission[26] is to: "Become a world-class university whose graduates, research and academic functions, attain and maintain high standards of quality." In terms of its development objectives, the university aims to: "Become a centre of wisdom for the kingdom and a source of knowledge for Thailand's people, while promoting advanced education to produce highly qualified graduates for the Thai and global society." As for its equity and outreach objectives, the

[25] Thailand's Ministry of Education, "Office of the Higher Education Commission". Available from http://inter.mua.go.th/about-us-ohec.

[26] Chulalongkorn University, "About CU: Vision and Strategies". Available from http://www.chula.ac.th/en/about/vision-strategies. Two objectives that are of relevance include: (1) Develop graduate production and manpower planning at the higher education level in line with the national needs (Bureau of Policy and Planning); and (2) Support development of student welfare and services to the disabled, disadvantaged and talented students (Bureau of Student Development).

university strives to: “Promote equal access to education for all and be supportive to all students and employees, while also giving full support to the community.”

4.3 Strategy and Innovation Initiative Level

The interview with Dr. Natcha Thawesaengsdulthai, Assistant to the President on Strategy and Innovation at Chulalongkorn University, demonstrates how the university puts into practice its stated objectives.

Dr. Natcha makes a distinction between traditional, more academic, engineering (civil, electrical, chemical, etc.) programmes, and the ongoing development within the university on cross-disciplinary programmes in engineering in the International School of Engineering[27] to address engineering solutions, society’s needs and global trends. Chulalongkorn University has had both of these approaches for more than ten years now. Twelve departments at the school fit within the traditional model.

Traditional engineering programmes and interdisciplinary engineering programmes are both evaluated according to their publications and published materials, research, teaching, contribution to society and other factors. Faculty participation in the Innovation Hub or I-HUB[28] (described in more details below) works because through I-HUB, faculty can contribute to society and, at the same time, publish their work. Simultaneously, the Dean can assess the progress across different faculties, and identify the strengths and weaknesses of the faculties based on their publications and public service innovations.

The new President of Chulalongkorn University is focused on not only meeting global goals, but also making progress towards addressing local priorities in Thailand. I-HUB is envisioned as: “A platform to nurture talents and develop innovations to help transform how Thais live, learn and play,” according to Dr. Natcha. Thus, I-HUB was established to connect Chulalongkorn University with various networks, including the Chulalongkorn University alumni networks, university networks, mentor networks, venture capital networks, startup networks, government, industries and non-governmental organizations.[29]

I-HUB has three focus areas:

1. Nurture and develop talent through innovation.
2. Develop innovations with economic and social benefits for Thailand.
3. Conduct innovations outreach to make it easier for society members to connect with resources at the university more inclusively.

Their activities include:

- Innovation academies that connect the different courses on creativity and entrepreneurship offered by different faculties in the university. They are general electives courses, and broaden the course options for students. Free non-degree

[27] The International School of Engineering was established in 2005 by the Faculty of Engineering of Chulalongkorn University to provide interdisciplinary knowledge and international experience.
[28] See http://innovationhub.chula.ac.th.
[29] CU Innovation Hub, "About Us". Available from http://innovationhub.chula.ac.th/about-us.

courses open to anyone at the university interested in entrepreneurship and innovation (similar to Stanford's D-School) will be launched soon.
- Innovation incubation with seed funding, mentoring and facilities to bring ideas to fruition.
- Innovation acceleration to transform ideas into products that benefit society.
- One-stop shop for innovation outreach.

The university is a public interest organization that is using big data to address public problems. Chulalongkorn University gets its revenue from land ownership in addition to the grants it receives from the government. Securing additional funding for public interest research is often a problem. The university is exploring additional support for public interest research by linking student research projects and capstone courses to actual problems expressed by the industry. Some students have developed innovative solutions that would be useful for the government. For example, I-HUB has been successful in connecting students with the Metropolitan Rapid Transit Authority to address a public interest issue and provide information on public bus system through development of an application called, "ViaBus". The students won a national ICT award for innovation for the application.

Another innovation that was showcased at the Digital Thailand 2016 Fair was the Claim Di application that speeds up the process of claiming insurance from insurance agencies after an accident. This application received funding of THB 71.6 million (about USD 2 million).[30] Another development-oriented application is a small drone system that tracks the weather at a very affordable price.

Dr. Natcha estimates that 10 per cent of the engineering graduates will be innovative entrepreneurs. For most graduates, however, a traditional career in a university faculty or industry is still more appealing.

4.4 Social Engagement

Dr. Pirongrong Ramasoota, the Head of Thai Media Policy Centre, Faculty of Communication Arts and Vice President for Information Services and International Affairs at Chulalongkorn University, further elaborated on initiatives at the institutional level from a social engagement perspective.

Since 2016, under the new administration, there has been a major focus on innovation. The four areas of focus are smart digital technology, aging, the smart and inclusive city, and food security/biodiversity. The university's I-HUB will be directed towards these focus areas, and will be physically located around Siam Square, an important commercial district near the school that is part of the university's endowment. Many of the initiatives being incubated there are ICT related, including a number of applications. Some of these applications have won global competitions. For example, I-HUB took part in a female entrepreneurship contest organized by the Israeli Embassy. The winner was a Chief Executive Officer of a farm technology company who is part of the university's international engineering programme.

[30] Chulalongkorn University, "CU Promotes Digital Start-Up and Innovation for Society at Digital Thailand 2016", 25 May 2016. Available from http://www.chula.ac.th/en/archive/7057.

This university policy aligns with the current government's overall development vision—Thailand 4.0—to transform the Thai economy into an innovation-driven economy. The idea is that creative initiatives, including smart digital ICT, should serve as a basis of the economy. With that in mind, Dr. Natcha has been developing memorandum of understandings with governmental and corporate partners to develop new human resources in ICT.

At the same time, Dr. Pirongrong wonders about what the university's strategy around access to these opportunities will be. In her opinion, policymakers are assuming that there will be a trickle-down effect that will help make these innovations benefit more people. She personally is sceptical, and feels that "a lot of people will be left behind". She also thinks there is a lot of duplication of research efforts as universities compete for world-class status. There is no hierarchical system of universities (like in India), and all the universities are competing to be the best. Universities speak about collaboration, but that is not something that Dr. Pirongrong sees happening in practice.

However, Chulalongkorn University has been involved in some social engagement research. For example, Dr. Pirongrong worked on a project called, "Engagement Thailand", which focused on universities' engagement with communities, including rural ones. Increasingly, emerging, provincial universities are finding it more convenient to carry out area-based research, while the urban universities are focused on metrics like publications to improve their rankings. The local universities would like to improve their rankings as well, but since it would take time, some of these universities have decided to focus their efforts on improving the lives of local communities. Nonetheless, these universities face resource and capacity constraints and limitations in the implementation of community initiatives.

4.5 Programme Level

According to Dr. Natawut Nupairoj, Head of the Department of Computer Engineering, the department has a high percentage of female faculty members. The reason behind this could be that male graduates are more interested in entering the industry than female graduates. It could also be because many of the faculty members are former scholarship students—as a condition of their university scholarship, recipients must work for the public sector for twice as long as they received the scholarship. It is possible that women are more likely to agree to these conditions, while men may want to have the flexibility to join the private sector for more lucrative work.

The Department of Computer Engineering has 304 bachelor's degree students across three years (in the first year they are completing general education courses), which translates into an intake of about 100 students per year. There are about 200 students in the three master's degree programmes (computer engineering, software engineering, computer science), and 33 students are pursuing their doctoral degree. Students that are enrolled in the master's degree programmes are mostly bachelor's degree graduates from programmes in accounting, engineering and sciences at Chulalongkorn University itself. At the Faculty of Engineering there are two entities that offer computer science degrees—one Thai and the other international. At the Thai school they have one bachelor's, three master's and one doctoral degree programmes. At the international school, a hybrid programme with IT and engineering is offered.

Table 2: Student enrolment and full-time faculty headcount across five surveyed countries

	Cambodia	Sri Lanka	India	Thailand	Republic of Korea
	CS (Yr. 2-4)	**CS&E**	**CS&E**	**CS&E**	**CS&E**
No. of students	2000	500	400	304	400
% Female	~7-8%	20%	15%	-	~30%
No. of faculty members	45	20*	30	36	32
% Female	4%	35%	10%	28%	3%
Student-teacher ratio	44	25	13	9	13
No. of master's degree students	60	200	50	200	~140
No. of doctoral degree students	-	2-3[#]	50	36	~100

Notes: CS = Computer Science; and CS&E = Computer Science and Engineering.
* 28 if visiting faculty members and those on study leave are included.
[#] None graduated yet.
Sources: Desk research and interviews, July-August 2016.

Comparison of enrolment statistics of similar computer science and engineering programmes in the five countries shows that the faculty resources relative to the student body at the university is generally correlated with the country's GDP per capita. The number of students per programme is roughly 300-400, and the student-teacher ratio is between 9 and 13 in the Indian, Korean and Thai case study programmes, with the Sri Lankan and Cambodian programmes lagging.

4.6 Innovations in ICT Education

The Department of Computer Engineering started its Big Data Initiative two years ago after seeing a decline in enrolment in the master's degree programmes. The department thought that by providing a focus they could improve the attractiveness of the programmes, and subsequently their numbers. This year they are indeed seeing the enrolment of higher calibre candidates. The department is also seeing an increase in the number of part-time candidates.

Judging from these facts, it can be concluded that the department is responding to market signals to provide a product that students want. In essence, the department is using its master's degree programmes to help define a strategy to move their programmes forward, as the feedback from master's degree students helps the department identify engineering topics of interest in the outside world and re-strategize as needed.

Based on the outcomes of the Big Data Initiative, the department has reorganized its curriculum, as well as its research around big data and data analytics, including working with industrial partners, and conducting big data seminars. They have guest lectures on big data about once a semester, although they would like to do additional support classes for students. The issue is time constraint as both faculty members and students already have a heavy workload.

The Faculty of Engineering has introduced an initiative called, "Education 4.0" that strives to include interpersonal skills within the curriculum to help train the next generation of engineers. While these are additional requirements for the faculty, Dr. Natawut believes that these skills can be taught and coordinated through existing classes. It is expected that the students will be able to gain not only the hard skills, but the soft skills as well.

Generally, the students' senior capstone projects have been influenced by the professors' interest, and may build on the work begun in an earlier year by past students. Recently however, more students have been interested to work on projects that are tied to industry and may be used by businesses. Last year the faculty had 102 students working on 66 projects—16 of the projects (24 per cent) were related to data analytics, and involved the work of 9 lecturers and 24 students. Other projects included an analysis of mobile users' movement pattern and e-books for blind users, among other initiatives.

PH21, a group of engineering students from Chulalongkorn University who joined together to create an innovative game called "Timelie", won the first prize in the Game Design category of the Imagine Cup Thailand 2016. Subsequently, they represented the university and Thailand at the World Finals Imagine Cup 2016, and won first place in the Games category.[31] Interestingly, the Sri Lanka team from the case study university in Sri Lanka for the present study won second place in the Innovation category.

Imagine Cup 2016 is a global student technology programme and competition hosted by Microsoft. This year's competition marks the 14th year that Microsoft hosted this programme, which is a platform for students around the world to use their creativity and innovative ideas to develop useful products for society.

4.7 Employability of Graduates

Chulalongkorn University conducted a survey in early 2015 and found that a third of their engineering undergraduate students continued to work in the ICT sector after graduation, a third go abroad for further studies, and a third switch fields to pursue careers in banking, economics, etc.

Dr. Natawut believes that the Department of Computer Engineering has very high-quality students in their programmes who can excel in many different fields, and upon graduation the students may find that they do not want to pursue careers in ICT. The survey found that many of the top executives in the financial sector are their alumni—a trend that have been observed in the last five years.

In the last two years, Dr. Natawut has also personally observed an increase in the number of alumni involved in start-ups. At the department, they have a class about high-tech entrepreneurship with 47 spots that they have offered for the past four to five years, and the class has always been full. Not everyone in that class will be an entrepreneur, but it indicates that the interest is high. Very few of the alumni work in the government sector.

[31] Pornravee Suramool, "Young Thai talents win Games category in Microsoft Imagine Cup 2016 World Finals", *Microsoft*, 1 August 2016. Available from https://news.microsoft.com/th-th/2016/08/01/ph21_ic16finals_en/#sm.0000r6kan2tnqfccrgt2qj3bmz2w4.

4.8 ICTD Alumni Perspectives

Dr. Natawut was approached to provide names of alumni who have made an impact with their innovations or contributed to ICT-enabled development in Thailand. Asked to name graduates who have gone on to serve the public interest, Dr. Natawut could recall the following:

- **Mr. Prasarn Trairatvorakul**, Governor of the Thailand Central Bank
    - Educational background – Bachelor of Engineering, 1974
- **Mr. Somkiat Tangkitvanich**, Director of Thai Development Research Institute
    - Educational background – Bachelor of Engineering, 1988
- **Mr. Yod Chinsupakul**, Chief Executive Officer, Wongnai
    - Educational background – Bachelor of Engineering, 2004

Below is an adaptation of a published interview of Mr. Yod Chinsupakul.[32]

Yod Chinsupakul was born and raised in Thailand. He founded and ran Wongnai.com since 2010, a leading restaurant review website based in Thailand—like the Yelp of Thailand. In 2015, Wongnai had over 1.6 million members and 400,000 reviews across over 100,000 restaurants in Thailand—and was still growing.

Yod stated that the tech start-up community in Thailand was growing very fast. When he founded Wongnai there were nearly no start-ups and there was no funding. In 2015, there were several hundreds of start-ups and tens of venture capital investors flying in from Singapore, Japan and the other countries.

Yod noted that he always lived in Thailand except when he was getting his MBA in the United States between 2008 and 2010, and felt that Asia was his home. The investor of his business, Recruit Group, was also from Asia—Japan.

On the topic of his favourite city, he said that Bangkok is where he lives and thinks that it is a city big enough for any business. It boasts close to 10 million people with a large middle-class population. It is a very vibrant and dynamic city with a lot of energy. Yod expressed an opinion that people in Bangkok like to live a good life therefore they are open to new things.

On the question of the best piece of advice he ever received, he said that it is important to spend more to get results faster. He further noted that one should not be afraid to double down in one's investment and go even deeper in the red in order to pick up the results and grow faster. According to Yod, that completely changed his view on why one would need investment. Yod noted that K. Paul Srivorakul, former CEO and Co-founder of Ensogo is an inspiration to him as he was the one who has given him that advice.

In terms of recently learnt lessons, Yod stated that he was impressed by the book, *Validated Learning and Innovation Accounting,* from Lean Startup. Although his company was already doing most of the things according to the Lean Startup way, Yod noted that some of his company's metrics were just "vanity metrics" rather than actionable metrics, and thus they were creating an unreal picture that they wanted to see, but not the reality.

[32] Callum Laing, "Yod Chinsupakul, Founder of Wongnai", *The Asian Entrepreneur*, 25 March 2015. Available from http://www.asianentrepreneur.org/yod-chinsupakul-founder-of-wongnai.

Reflecting on his past and what he would do differently, Yod said that he would hire an accountant earlier on as it would have saved the company a lot of time and confusion over consolidating the receipts, tax invoices, etc. Also, he would register the company in Singapore rather than Thailand (an entity in Thailand but parent company in Singapore), as, in his opinion, Singapore is like the Delaware of South-East Asia.

5. Summary of Observations and Conclusion

This case study of Thailand illustrates that government initiatives and other interventions have been contributing to positive education outcomes, in particular towards gender parity in the fields of science and technology, including ICT. This study finds that Chulalongkorn University registers a higher ratio of female students in the surveyed programme than most of the programmes included in this five-country study. Necessary ICT connectivity, provided through the private operator and research networks, is in place to encourage innovations and applications around engineering and ICT-related programmes. Affordable ICT connectivity at the IHL has paramount importance. The study shows that this is supported both at national and IHL levels. The government ensures that all IHLs are connected via NREN, and the IHL has established its own internal networks.

Interesting features emanating from this study include commitments and efforts made by Chulalongkorn University's leadership towards promoting innovations and relevance to the country's development priorities, by implementing initiatives such as I-HUB. Additionally, the active participation of the university in regional and international competitions in the areas of science and technology are reported to have positive impacts. Some applications developed at I-HUB, for example, have won awards, such as Microsoft's Image Cup, which is a platform for students around the world to use their creativity and innovative ideas to develop useful products for society. Another application developed at I-HUB that won a national ICT contest was ViaBus, which was designed for better public transportation management. As is the case in other countries, the Thailand study demonstrates the importance of initiatives such as I-HUB, as a platform for innovation and business incubation.

Furthermore, the university has been proactively seeking partnerships with government and private sector partners to ensure that their programmes are relevant to the needs of the government and companies. In particular, the new focus on big data and data analytics seems to have gained traction as demonstrated in the increased interests by applicants and students alike. The study underlines the importance of linking university programmes with industry/business. The interviews conducted for this country study reveal a widespread interest of students and graduates in exploring the applicability of their studies and research in the private sector, start-ups and employment opportunities. No doubt initiatives such as I-HUB can help graduates enhance their recognition and employability in the private sector, particularly in the ICT sector.

The study, however, finds that there are very few graduates who wish to pursue careers in the government sector. Moreover, Dr. Pirongrong expressed her doubt that the above-mentioned innovations would trickle down to a wider population and bring about socioeconomic benefits on a wider scale. While students generally prefer working on projects related to businesses, the topics ultimately depend on professors' discretion. Of the 102 students who worked on 66 projects in the surveyed faculty, 16 were related to data

analytics, of which one was the development of e-books for blind users. More could be done to address societal and environmental challenges, by encouraging students, graduates and researchers to develop applications and systems to achieve the Sustainable Development Goals and other national development goals, using their skills, talents, expertise and knowledge. Perhaps new incentive and partnership schemes, such as a competition for mobile applications and data analytics on social and environmental issues, or collaboration with new and provincial universities, could be considered, as the latter seem to be responding to development issues in particular localities.