



Royal University of Phnom Penh



Sida

Information and Communication Technology Policy 2017 - 2020



Message from Dr. Mey Kalyan Chair of Board of Trustees of RUPP

In the past decade, Cambodia has seen steady economic growths at around 7% annually. Nevertheless, Cambodia still needs more development to uplift the living conditions of her people. The key toward more sustainable development is maximizing capabilities of Cambodia's youth to prepare them for a knowledge-based economy, in which research is foundation for real knowledge and for positive changes of the society.

In line with this awareness, in the 2014-2018 strategic plan, the Royal University of Phnom Penh (RUPP) stated very clearly its intention to be the flagship university of Cambodia in research, community services, learning and teaching. It outlines goals and strategies to be done in the years to come. To achieve this goal, RUPP has worked very closely with all its development partners to reform financial management and human resource management while at the same time restructuring its organisation structure to be more responsive to community and job-market needs.

It was part of this reform and restructuring process that the Board of Trustees of the university decided to establish a culture of research among the faculty members. Annual research budget was securely allocated and research capacity development have been one of the priorities.

Noticing the clear strategic plan and strong commitment to be the true flagship university of Cambodia, Swedish International Development Authority (Sida) has chosen RUPP to be a long-term development partner. Sida aims at strengthening the research capacity in RUPP to respond to both social and academics needs. However, to do research, ICT infrastructure needs to be in place. This ICT policy and master plan is result of the joint effort between Sida and RUPP to ensure that ICT infrastructure can be brought into existence in a more sustainable manner.

The Board of trustees of RUPP has been informed of the ICT policy and master plan and has approved of both the policy and plan. We are grateful that Sida is going to work closely with RUPP to realize the first set of priorities for good governance and research. As the Chair of Board of Trustees and on behalf of other Board members, I would like to endorse this policy and master plan. We will do everything possible in our capacity to make sure the plans can be materialized so that RUPP can be truly a flagship university.

I thank Sida, the Swedish embassy in Phnom Penh, and all RUPPers who work tirelessly to make this policy and master plan a reality.

Faithfully Yours,



Mey Kalyan, PhD
Chair of Board of Trustees

Foreword by Dr. Chet Chealy Rector of Royal University of Phnom Penh

Technology is making great contribution to improve life and society. Recently, the MIT technology review listed ten breakthrough technologies of 2017. These include reversing paralysis, self-driving cars and trucks, paying with your face, practical quantum computers, the 360-degree selfie, hot solar cells, gene therapy 2.0, the cell atlas, botnets of things, and reinforcement learning. All these breakthroughs hold great promises for the society.

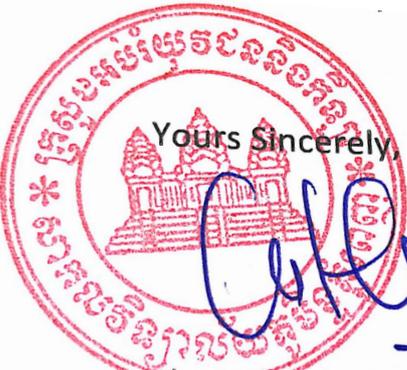
At RUPP, we recognize the significances of technology, particularly information communications technology or ICT. We intend to integrate ICT in all our functions and services. ICT makes it possible to store, retrieve, transmit, receive, and manage information to the mass in a timely manner. It is such a system that RUPP is going to adopt to make research, teaching, learning, and student services responsive and reliable. It starts with RUPP having its own ICT policy and master plan.

The ICT policy and master plan emphasizes on facilitating the following services: connectivity and common network services; learning and research; university management and administration; governance, management, control, and maintenance of ICT resources. To realize these possibilities, the ICT policy and master plan also outlines a careful change management and monitoring and evaluation plans.

I am thankful to the government of Sweden, which, through their development authority, Sida, and the Swedish embassy in Cambodia, work closely with RUPP to realize the university vision, i.e., **“to become Cambodia’s flagship university in teaching, research, and community services”**.

I also thank all staff, teachers, and students at RUPP who contributed to the development of this policy. We are going to work together to implement the ICT policy and master plan so that RUPP could be a truly “Cambodia’s flagship university”.

Yours Sincerely,



Chet Chealy, PhD
Rector

Foreword by Mr. Magnus Saemundsson Sida's Representative

The new ICT Policy and Master Plan is a great step forward in making RUPP a flagship university of Cambodia. Modern and up to date ICT infrastructure is a prerequisite for conducting modern university teaching and learning. Without access to databases and international science journals scientific research cannot be conducted in line with international standards.

Sida and the Swedish Embassy in Cambodia welcome warmly this important step that we believe will be able to fundamentally strengthen RUPP as a high quality comprehensive university.

Yours Sincerely,

A handwritten signature in black ink, reading "Magnus Saemundsson". The signature is written in a cursive, flowing style.

First Secretary, Education and Research
Swedish Embassy, Cambodia

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Executive Summary

RUPP’s ICT Policy and Master Plan (2017-2020), here after “policy and plan”, aims at integrating ICT into all aspects of university life for students, staff, and faculty members. Specifically, the policy and plan will make it possible for ICT to facilitate the following areas for effectiveness and efficiency: (1) teaching, learning, and research; (2) academic administration and management; (3) library administration and management; (4) finance administration and management; (5) human resource administration and management.

Funded by Sida but driven by all at RUPP from support staff to top management, this policy and plan will guide the implementation of the infrastructure, databases, information systems, and corresponding processes and procedures in order to support the functional and policy level aspiration of the Royal University of Phnom Penh.

The policy has the following key policy statements.

RUPP shall:

- i. Implement an ICT governance environment that ensures that all stakeholders have a say at the appropriate level in determining the functionality, specification, and service levels of all ICT services and systems
- ii. Establish/sustain a specialised ICT Support Unit responsible for the management, control and maintenance of ICT systems and services to ensure the availability to users at the agreed service levels
- iii. Ensure that ICT services and systems are sustainable by:
 - a) Allocating sufficient financial resources, combined with an ICT Fee chargeable to every student, to cover, as a minimum, the recurrent costs of all ICT services and systems and also provide for growth and continuing modernisation;
 - b) Ensuring that the ICT Support Unit is staffed with a sufficient range of human resource and skills combined with remuneration that recognises the reality that RUPP has to compete with the private for the kind of technical human resource that is able to ensure availability of ICT services and systems at the required service levels.
 - c) Using acquisition policies (for example local development wherever possible as opposed to buying proprietary systems; university-wide open source policies; etc.) that minimise recurrent costs while also building local capacity;

To materialize all components of the policy and plan, a budget around five million US dollars is needed. Sida will fund the first few key components to kick start the process. These prioritized areas include: (1) improving and expanding the campus data backbone, (2) improving and setting up LAN in buildings, (3) strengthening of ITC in terms of personnel, capacity, and equipment, (4) strengthening the Network Operation Center and the Data Center, (5) intranet / internet (including E-mail and access to intranet and internet services as well as automation, (6) academic management IS, (7) library management IS, (8) human resource management IS, (9) finance management IS, (10) executive management IS, and finally trainings to all concerned end users. (see table 1 on page 7 of the master plan). RUPP will need to fundraise the rest of the money from all stakeholders and development partners to realize the remaining plans.

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Abbreviations

Term	Description
AWG	Architecture Working Group
CAMREN	Cambodian Research and Education Network
DNS	Domain Name System
DRC	Disaster Recovery Centre
DSL	Digital Subscriber Line
ICT	Information and Communications Technology
ICT/MP	ICT Policy and Master Plan
ITC	Information Technology Centre (of the Royal University of Phnom Penh)
ITU	International Telecommunications Union
IP	Internet Protocol
IPR	Intellectual Property Rights
IRM	Information Resource Management
ISP	Internet Service Provider
Kbps	Kilobits per second
LAN	Local Area Networks
LCMS	Learning Content Management System
NOC	Network Operations Centre
NREN	National Research and Education Network
Mbps	Megabits per second
MCM	Management, Control, and Maintenance
MDA	Ministries, Departments and Agencies
MEF	Ministry of Economy and Finance
MoEYS	Ministry of Education, Youth and Sports
OPAC	Online Public Access Catalogue
PoP	Point of Presence
RUPP	Royal University of Phnom Penh
Sida	Swedish International Development Cooperation Agency
VOIP	Voice over IP

1. Introduction

1.1. The National Context

RUPP, founded in 1960, has the Vision, according to the University Strategic Plan 2014–2018¹ **“To become Cambodia’s flagship university in teaching, research and community services”**. It is the oldest, largest, and premiere university of Cambodia. The quality and conduct of education, research, and administration at the university is therefore very important in shaping Cambodia’s human resource and will therefore impact on national development. This alone requires that education, teaching, and research are conducted in a way that will produce graduates compatible with 21st century development demands. Figure 1 representing the Cambodia ICT Master Plan 2020² brings into focus the reliance on and key responsibility of RUPP as the main source of educated human resource in the country.

“Empowering people” includes equipping people with the necessary ICT skills to create a pool of talent and building people’s awareness of the pros and cons of ICT, all of which is necessary for the country to be able to leverage the potential of ICT for social economic development.

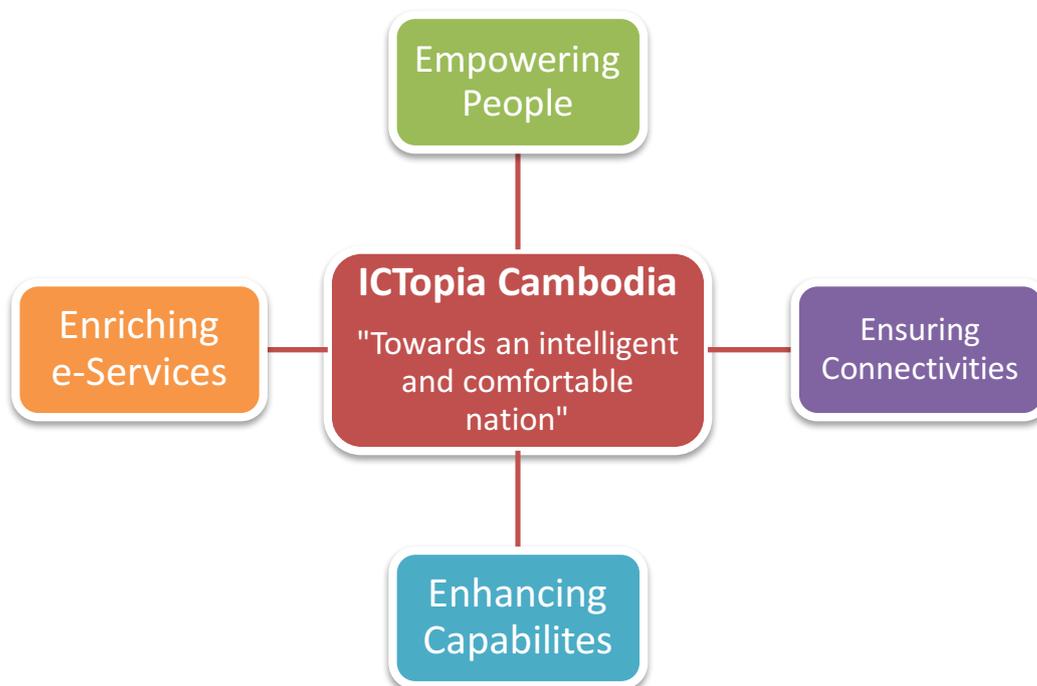


Figure 1: Overview of Cambodia ICT Master Plan

¹ RUPP’s Strategic Plan 2014-2018, <http://bit.ly/1MVLn8Z>

² Cambodia ICT Master Plan 2020, www.trc.gov.kh/summary-on-cambodian-ict-masterplan-2020

1.2. Assessment of the ICT Environment at RUPP

Effective research and research collaboration require a supportive information and communication technology (ICT) ecosystem. A study supported by Sida to evaluate the ICT environment³ revealed various gaps and constraints:

- i. There is insufficient external bandwidth for the campus population taking into account the large number of devices (more than 35,000⁴ phones and laptops in addition to the more limited number of desktop computers). The total available bandwidth of about 45Mbps is also fragmented, in many cases lacks service levels, and is not integrated and managed for efficient utilisation.
- ii. There is no Intranet, meaning that the most popular access services like email, e-learning content, and information about the university activities have to be accessed using external servers, compounding the challenge of limited bandwidth. The absence of an Intranet also makes it impossible to provide easy access to internal and external online services and resources.
- iii. The campus network and the related Wi-Fi coverage are still limited. The current Wi-Fi coverage can only accommodate a maximum of 400 to 500 hundred connected devices at any time. Even if demand diversity is taken into account, the number that can be served remains extremely low. Active devices that are old and generally limited in capacity compound this. Students are limited to one hour of use per day, way below the desirable full time access in a modern academic institution.
- iv. Students are not allocated with institutional email addresses, a result of the lack of an Intranet, making communication from staff to students difficult and expensive. Staff is allocated email addresses but their usage is limited (due to a combination of limited infrastructure, lack of ICT skills, and limited awareness).
- v. There are very limited computer resources for the 15% or so students who do not have access to computers or their own laptops. Since these would inevitably be the students from the poorer backgrounds, they are marginalised even at the university.
- vi. The IT Centre (ITC) is very limited in terms of equipment and other tools for rolling out, and for management, control, and maintenance (MCM) of the ICT resources.
- vii. The ITC staff is still limited in terms of both exposure and specialised skills for MCM of a modern data communication network. They for example have good insights into what Academic Records, Finance and Human Resource systems would be like, but clearly need to understand the issues better, and to have the line departments involved a lot more in defining functionality. Another specific area of skills needs is specific to the design, rollout, configuring, and operating advanced data networks.
- viii. Salaries paid to ITC staff are very low, forcing them, like the rest of the university community, to look for other means of making ends meet. The availability and reliability of

³ See “Opportunities for Harnessing ICT to Support Research and Research Collaboration at the Royal University of Phnom Penh”. Sida Report. The 35,000 is composed of: 18,000 student phones; 1,000 staff phones; and 15,000 laptops of varying power among the students (especially after Year 1) and staff; and the different computer labs around the campus.

⁴ *ibid*

comprehensive modern ICT services and systems in an institution the size of RUPP will require the full-time and undivided attention of all ITC staff.

- ix. There appears to be limited awareness among decision makers who control the budget, who are all external to RUPP, about the benefits of ICT in enabling achievement of the RUPP vision, mission, and strategic objectives. We have observed that this could be a challenge of packaging and communication of the message from RUPP.
- x. The electronic journal databases critical to some courses (especially the sciences) among the current offerings through the Hun Sen Library are limited.
- xi. While there is desire of transitioning to e-enabled education for a better learning environment and experience, almost all the lecture rooms are not e-enabled.
- xii. The software available for general usage is very limited in scope, with academic staff members failing to get the applications they would wish to use. Staff members often make individual efforts to acquire software, but run into version and other compatibility challenges when they try to share information (cited especially by those who need access to student records). Viruses are also a challenge because of limited deployment of effective anti-virus software.
- xiii. While there are two standalone databases acquired to manage: student academic records and another to store the staff payroll, there are no real information systems for students' records management, staff records management, or financial management. There is major challenge of tracking students – graduate students for example register with the different graduate programmes in faculties rather than the Student Office. There are also mismatched student identification numbers issued by different units (Students Office and IT Centre). This was explained as a transition challenge, and we were informed that the process to improve identification numbers is being carried out.
- xiv. The information on the university web pages is out of date
- xv. There is a dual language challenge when it comes to electronic data entry because Khmer characters are different for Latin characters.

It was agreed by RUPP management that the multiple challenges summarised above could not be addressed in a coordinated, synergetic, and cost-effective manner without a guiding policy and strategy framework, the ICT Policy and Master Plan (ICTP/MP) of the University. This activity was agreed by the RUPP as the priority undertaking before all the other challenges could be addressed.

It should be noted that this policy covers four years, 2017 – 2020: this can be considered as the foundational phase for the full integration of ICT in all RUPP functions. The foundational phase will provide the platform for taking RUPP to a higher level of exploiting ICT compatible with universities in more technologically developed regions.

1.3. Improvement Drivers

The assessment of ICT at RUPP also identified Improvement Drivers, the things that RUPP staff and students wish to do using any form of ICT to enable their work, studies, or research, and which would therefore ensure that ICT is being used to support the RUPP Vision, Mission and Strategic Objectives. These are the real motivation for using ICT.

1.3.1. Efficient Communication

The RUPP community needs efficient, reliable and timely communication to the internal and external environments. Most of the efficient communication methods rely on internal and/or external connectivity, and complaints about slow Internet, and insufficient or unreliable Wi-Fi coverage as well as limited online time for students, which were the leading complaints in all discussions, are driven by this.

1.3.2. Easy and Fast Access to Online Resources

The RUPP community needs easy and fast access to online resources, including academic materials, social media utilized for communication and dissemination purposes, and general sources of information.

1.3.3. Easy Access to Accurate and Consistent Data about the University

All academic, administrative, and managerial functions call for easy and timely access to data that is accurate, up to date, and consistent, relating to students, staff, infrastructure, library holdings, finance, programmes and courses, etc.

1.3.4. Access to Online Services on Demand and any Time

A modern, efficient, and high-reputation academic institution requires that all staff and students are literally able to access the Internet and the organizational Intranet all the time. Many of the academic staff have had, through study abroad, opportunity to work in such environments, and therefore cannot be satisfied and rightly feel that they have limited productivity in an environment that does not provide this for both them and their students.

1.3.5. Efficient Academic and Administrative Processes

Organisational efficiency and competitiveness requires minimizing the time between input and output for any of the organization business processes. This in turns requires that steps that do not add value in administrative processes are eliminated; that with common access to information all levels in the organization are empowered to take certain decisions; and that the re-engineered processes are placed online and automated so that human intervention comes in only where discretionary decisions are required.

1.3.6. Coordinated Approach to Integrating ICT in the Organisation

Efficient utilization of resources and consistent and measurable improvement always needs overarching organizational policy and strategy that binds everyone. In the absence of that, different units will move in different direction.

1.4. The ICT Policy and Master Plan: Key Elements

This ICT Policy and Master Plan spells out:

- i. The high level policy intent of integrating ICT into all aspects of university life, driven by the vision and mission of the university;

- ii. The specific aspirations and requirements that will guide the integration of ICT in each aspect of university life, viz:
 - a. Teaching, learning, and research
 - b. Academic administration and management;
 - c. Library administration and management;
 - d. Finance administration and management;
 - e. Human resource administration and management;
- iii. The specific aspirations and requirements that will guide the implementation of the infrastructure, databases, information systems, and corresponding processes and procedures in order to support the functional and policy level aspirations of RUPP;
- iv. The ICT Management environment from the policy to the operational level;
- v. The Implementation Master Plan based on the agreed priorities, along with costs of implementation;
- vi. The sustainability plan (organizational, human resource, and finance) to ensure that investments in ICT are not only maintained in a state that enables achievements of the policy objectives but can also, with time, be built to greater levels of penetration and sophistication; and
- vii. Approaches to Change Management as well as Monitoring and Evaluation, a means of keeping a constant eye on the process so that all risks are recognised and addressed proactively, and tactical or strategic changes addressed timely.

Without a good Policy and Master Plan, there is a high risk that investments in ICT will become an increasing cost without the resultant organizational benefits to justify them. A good ICT Policy and Master Plan must be owned by all levels of the organization, especially top management, as it will lead to organizational changes and challenges that need to be constantly addressed at that level.

1.5. Formulation of the ICTP/MP

The ICT/MP was formulated drawing on the following sources of information:

- i. The Study of the ICT Environment at RUPP (November 2015)
- ii. The Stakeholders Workshop that was also the main decision forum about policy, strategy, and priorities. The Stakeholders Workshop was a critical step in creating ownership, a core element of the success of any policy.
- iii. The experience and expertise of the consultant in providing experiential input as part of the decision-making processes and also in drafting.

The discussions with various members of the university community were conducted using semi-structured guides. For the self-administered questionnaires the samples were not designed to be representative, but the numbers and distribution used, covering all faculties as well as

administrative and support units, were sufficient to provide a reliable feel of the entire university community. In confirmation of this, it was noted that the results from the self-administered questionnaires were consistent with the findings from the interviews.

1.6. Document layout

The first chapter provides an introduction to the ICTP/MP, giving the motivation as well as the process of its development. It also outlines the key elements of the ICTP/MP. The key policy statement, setting the direction and aspirations of RUPP in exploiting ICT, are given in Chapter 2. Subsequent chapters expand on each of the policy statements, addressing the core Information Systems in Chapter 3; End-User Training to the extent that it is needed in Chapter 4; E-learning in Chapter 5; and Connectivity, Network Infrastructure and Services in Chapter 6. The ICT Management Policy is detailed in Chapter 7. Finally, Change Management and Monitoring and Evaluation are addressed in Chapters 8 and 9 respectively.

The detailed Master Plan, giving the prioritised projects as agreed by the Stakeholders' Workshop; the budgetary cost estimates of each, and the implementation timelines, has been produced as a separate document.

2. Key Policy Statements

The Royal University of Phnom Penh recognises the imperative of integrating ICT in all its functions driven by both the national development need for graduates equipped for the 21st century, and the university vision: ***“To become Cambodia’s flagship university in teaching, research and community services”***. The following policy statements have been adapted to provide the guiding framework for the integration of ICT into all university functions, and to give specific guidance to the implementation Master Plan.

The Vision of the ICT Policy is ***“A university where ICT is exploited to ensure effectiveness and cost-efficiency in learning, research, and administration in order to support the institutional Vision and Mission”***.

RUPP shall establish an environment where ICT can be sustainably exploited to improve connectivity and common network services; learning and research; university management and administration; as well as governance, management, control, and maintenance of ICT resources guided by the following policy statements.

2.1. Connectivity and Common Network Services

RUPP shall:

- i. Ensure access by all students and staff to common network services by implementing an Intranet consisting of: a single access portal to all university online applications and services; and intra-campus networks on all campuses as well as inter-campus connectivity utilising technologies that are forward looking and also ensure that all staff and students can get access to unlimited bandwidth for intra or inter-campus level applications and communication anywhere on the campuses. For clarity, unlimited in this context means that bandwidth should never be a constraint for education, research, administrative, managerial and collaboration applications that run on the university intranet.
- ii. Ensure that all students and staff have access to high speed broadband for national, regional, and international education and research collaboration and communication. “High speed broadband” here is defined as having the key attribute of “always on”. The minimum download speed should be equal to or higher than what is stipulated in the Cambodia National Broadband Policy⁵. RUPP will specifically play an active role in the national research and education network of Cambodia in order to promote national, regional and global connectivity and collaboration.
- iii. Implement on-going training programmes that ensure that all students (during their first semester) and staff (during the first three months after recruitment) have the requisite awareness and skills to work in a fully online environment

⁵ The Cambodia National Broadband Policy of 2013 specifies and always on connection with a minimum download speed of 512 Kbps, and provides for continuing revision upwards. It does not define high speed broadband.

2.2. Learning and Research

RUPP shall Improve the efficiency and effectiveness of learning and research by:

- i. Modernising all lecture rooms to ensure that they are suitable for both traditional and collaborative online learning methodologies
- ii. Modernising all labs to enable, where needed, computer-driven experimentation and simulations as well as access to remote labs;
- iii. Retraining lecturers to understand the advantages and limitations of e-learning using student-centered self-led learning approaches, including content preparation, discussion mediation, and grading;
- iv. Establishing a rewards system that recognises the demands of online learning
- v. Implementing a locally hosted E-learning System to enable use by early-adapters;
- vi. Developing and implementing a holistic E-learning Policy
- vii. Developing and implementing a holistic Research Policy and a Research Management System

2.3. University Management and Administration

RUPP shall Streamline and create efficiency in managerial and administrative functions, and improvement of accuracy and timeliness of reporting by:

- i. Implementing computerised academic, financial, library, human resource, and executive management information systems. It shall be a requirement that all these systems are compatible with each other and will draw data from common university databases.
- ii. Implementing an application that draws data and information from all university information systems to enable automated generation of high level management information reports.

2.4. Governance, Management, Control, and Maintenance of ICT Resources

RUPP shall:

- i. Implement an ICT governance environment that ensures that all stakeholders have a say at the appropriate level in determining the functionality, specification, and service levels of all ICT services and systems
- ii. Establish/sustain a specialised ICT Support Unit responsible for the management, control and maintenance of ICT services and systems to ensure their availability to users at the agreed service levels
- iii. Ensure that ICT services and systems are sustainable by:

- a. Allocating sufficient financial resources, combined with an ICT Fee chargeable to every student, to cover, as a minimum, the recurrent costs of all ICT services and systems and also provide for growth and continuing modernisation;
 - b. Ensuring that the ICT Support Unit is staffed with a sufficient range of human resource and skills combined with remuneration that recognises the reality that RUPP has to compete with the private for the kind of technical human resource that is able to ensure availability of ICT services and systems at the required service levels.
 - c. Using acquisition policies (for example local development wherever possible as opposed to buying proprietary systems; university-wide open source policies; etc.) that minimise recurrent costs while also building local capacity;
- ii. Develop and implement policies and procedures to ensure the security of ICT hard and soft resources, and implement a continuing programme for creating awareness about cyber-security and the roles, responsibilities, and obligations of each user to ensure this.

2.5. Change Management

RUPP shall require that before any project implementation plan is rolled out, it must be demonstrated to have convincing plan for change management in order to maximise the likelihood of success and reduce the likelihood of failure. The change management plan shall as a minimum address the following:

- a) Creating awareness among functional staff and end users about the planned changes and their motivation, addressing both institutional and individual benefit;
- b) Ensuring that ownership among all stakeholders is created through their involvement in conceptualisation, planning, and implementation;
- c) Explaining the consequences of what was being done with respect to the day to day functions of especially staff, and incorporating what will be done to ensure that staff is not negatively impacted by the changes (training, re-skilling, transitioning new job assignments, incentives and benefits, etc.);
- d) Explaining the stakeholders' roles in ensuring success along with the basis for evaluating success and how this will be done; and
- e) Mainstreaming recurrent and obsolescence costs in the university budget.

2.6. Monitoring and Evaluation

RUPP shall require that:

- i. At the overall ICT Project level, output, outcome and impact level indicators as well as the methods of measurement are identified and baseline values established as a starting point for setting and tracking institutional level targets, as well as adaptively adjusting tactics, strategies, and policies. These will be reported on annually, and the five-year ICTP/MP shall regardless be reviewed on a rolling basis at least once every two years.

- ii. It is a requirement that each sub-project design incorporates a monitoring and evaluation plan that incorporates indicators as well as the methods of measurement at the output, outcome, and impact levels; and also enables tactical or where needed, strategic adjustments.

3. Information Systems

This chapter outlines the core standard functionality requirements of the major information systems as well as key considerations during implementation. It should be noted that while the ICT Support Unit provides cross-cutting support, the functional units of the university own the various information systems, and these must lead in the definition of functionality requirements for each such system. Table 1 identifies the units that own each of the major information systems.

Table 1: Major information systems required by a university

	Information System	Owner
1	Library Management	Vice-Rector, Library and Research
2	Academic Management	Vice-Rector, Academic Programs
3	Finance Management	Vice-Rector, Finance and Accounting
4	Human Resource Management	Vice-Rector, Administration
5	Executive Management Information System	Rector

3.1. Library Management Information System

3.1.1. Findings by the Stakeholders' Workshop

- i. There are multiple library holdings on campus in the main library and in other locations, but it is very difficult for students and staff to know what is held and where. There is need for a unified open public access catalogue that enables staff and students to easily locate books and journals available within RUPP at any location.
- ii. Most users do not know how to find materials or use library resources, and the Library does not have enough staff to help everybody, including reference consultation services. There is need for an easy to follow step-by-step guide that users can work through on their own.
- iii. The library holdings are limited in range and quantity, especially when it comes to journals required for science-based research. The limited quantity means that only two items can be borrowed at a time (for two weeks). There is need to address this through both funding (range of holdings) and conversion of holdings to digital format (ease of multiple-access of unlimited duration – including materials that would normally have to be reserved).
- iv. Lecturers do not normally use the library, and in this set a bad example for students.
- v. The Library lacks qualified staff and has an insufficient budget for the required books and journals. This calls for both budgetary allocations and staff training/retraining in recognition of the fact that if RUPP is to become a research oriented university that also has high academic performance; the Library plays a crucial central role.
- vi. There is very limited Internet access, critical for accessing online journals to some of which the university subscribes. There is need to create more efficient access and therefore more efficient research by increasing available bandwidth.

Most of the challenges in the Library can be handled through a computerized Library Management Information System with the key modules for acquisition, cataloguing, and circulation; backed by a robust plan to have all holdings in digital form; supported by policies that require the university to have a unified catalogue. The Library will certainly, outside ICT, need financial support to expand holdings and subscriptions, recruit and train/retrain staff, and mount an awareness campaign as part of a broader initiative to improve instruction and research at RUPP.

3.1.2. Policy statement

A computerised Library Management Information System will be implemented in order to improve the efficiency and effectiveness of library operations and services.

Essential functional requirements

- Circulation Control System.
- Catalogue Maintenance System giving a high quality of bibliographic records in conformity with the standard cataloguing codes.
- On-line access to a unified catalogue.
- Ability to share resources (catalogues) among libraries at different locations.
- Acquisitions Control, including search of on-line sources of publications, on-line access to book dealers and book publishers and order placement, checking in, query on-order records.
- Serials Ordering and Control.
- On-line (through Internet) access from any workplace to Reference and Information Services (indexes, abstracts, etc.) in the University library and other universities, libraries, and institutes.
- Statistical reporting and management information provision.
- Provision of Library ICT services: E-journals, archiving e-docs, research dissemination, e-granary, self-check-in/out systems

The following should be considered as key implementation issues in creating a modern library at RUPP:

- i. Digitising all Library holdings to create convenience for users and minimise the need for physical access to holdings. Digitising is a major and specialised undertaking, and a cost-based decision will need to be made about doing this in house or out-sourcing.
- ii. Implement a policy that requires that all research papers, dissertations and theses are submitted in digital format.
- iii. Re-training Librarians so that they can mediate access to information in a computerised Library.
- iv. Training users (both students and staff) to create both Internet and knowledge literacy.

3.2. Academic Management Information System

3.2.1. Findings by the Stakeholders' Workshop

- i. Tracking attendance of students in lectures is difficult and takes up a lot of time. There is a need to implement a system that automatically tracks student attendance.
- ii. Students are confused by the registration process, including the selection of subjects (for example majors); and it takes a long time and in multiple locations (Finance, Academic Office, Library). There is need for a system that explains the process of registration to the students even before they report to the university and to the extent possible enables them to complete most of the processes before they report.
- iii. Students have to pay fees on campus before they can register, and the assessment, payment, and registration are all done at different places. There is need for a system that enables students to pay directly into the university bank accounts, with the payment information automatically picked up by the university through the bank system.
- iv. Students have a challenge finding their way around the campus. There is need for a university map showing the locations of different offices, lecture rooms, and functions
- v. The numbers of students admitted exceed lecture-room sitting space. There is need to match admissions and registrations to available lecture room space, and to allocate lecture-rooms according to the number of students taking a given subject.
- vi. There is a large knowledge gap between students from the city schools and those from the rural areas. There is need for a system of remedial classes to be run prior to the start of the university term.

The challenges in Teaching and Learning can be addressed through a computerised Academic Management Information System that handles admissions, registration, time-tabling, and tracking of performance and graduation, all designed to take into account the specific challenges and policies in Cambodia

3.2.2. Policy Statement

A computerised Academic Management Information System will be implemented in order to enhance and streamline student education and related administrative and managerial processes; and to improve academic reporting facilities at both central and faculty level.

Essential functional requirements

- Management of student personal records.
- Admission of students.
- Management of student academic performance records and student academic performance analysis.
- Curricula and course records management (Academic Program Offerings).
- Class scheduling (time tabling).

- Space and teaching staff requirements analysis.
- Support for joint admissions among universities and academic credit transfer.
- Students' financial transaction management.
- Students' health records management.
- Students attendance monitoring
- On-line database query and reporting facilities.
- Alumni records and activities.

The following should be considered as key implementation issues for the Academic Records Management Information System.

- i. All student records will need to be digitised. Once a start date is set, all first year and continuing students admitted after the start date must have fully computerised records. The records of continuing students would also need to be computerised, after which all records of previous students, working backwards, will also need to be computerised. Again the enormity of this task might call for outsourcing, but with sensitivity to the needs to assure the integrity of academic records.
- ii. There will be need for liaison with the Finance and Accounting department, as registration requires payment of fees.
- iii. There will be need to liaison with the Human Resource department to obtain information about academic staff to be deployed in teaching.
- iv. There will be need for a linkage to the E-Learning System when this is implemented.

3.3. Finance Management Information System

3.3.1. Findings by the Stakeholders' Workshop

The Finance Department faces challenges related to:

- i. Management of fixed assets
- ii. Inventory management
- iii. Tools for tracking and providing up-to-date information on student payments
- iv. Tools for tracking and checking teaching/working hours, which is the basis for payment
- v. Preparing and submitting routine and statutory financial reports to support management and decision making (both internal to the university and to government)

A good computerized Finance Management Information System that is integrated with the rest of the university information systems, and also linked to external banks would address most of these challenges. It should be noted that the Finance Management Information System will be required to

be compatible with information systems in the Ministry responsible for Finance in the government of Cambodia for reporting purposes.

3.3.2. Policy Statement

A computerised Financial Management Information System will be implemented in order to enhance and streamline financial management processes and reporting facilities at both central and faculty level.

Essential functional requirements

- Budget preparation, implementation, monitoring, reporting and evaluation.
- Debt management.
- Cash management.
- Foreign aid management.
- Revenue management including assessment of financial needs, collection of gifts, determination of tuition fees, government appropriations, contracts and grants, investments, sales.
- Expenditure management including authorization of expenditures, personnel costs, vendors, awards.
- Personnel cost administration (payroll).
- General ledger.
- Budget ledger.
- Commitment ledger.
- Accounts payable.
- Accounts receivable.
- Fixed asset management.
- Inventory control.
- Cost accounting functions.
- Financial analysis and reporting capabilities.

The following should be considered as key implementation issues for the Financial Management Information System:

- i. There will be need for liaison with the Academic management department regarding payment of fees.

- ii. There will be need for liaison with the Human Resource department management departments regarding payment salaries and other benefits: this is especially important for the coordination of the Payroll module that is housed and owned by the Human Resource Department.
- iii. There will be need for interfacing with banks so that student fees payments are automatically picked up by the university; and that there is smooth payment of salaries into individual staff accounts.
- iv. There will be need to interface with the government financial system.
- v. There will be need to digitise all current, and to the extent that the RUPP and Cambodian law require, to also digitise historical financial records.

3.4. Human Resource Management Information System

3.4.1. Findings by the Stakeholders' Workshop

Human Resource Management faces challenges related to:

- i. Clear identification of roles and responsibilities for each staff member
- ii. Tracking punctuality and presence at the work place (also related to remuneration)
- iii. Performance appraisal
- iv. Having a consolidated and consistent record for each member of staff
- v. Staff motivation

There is need to address this through a computerised information system that:

- Captures and through which information and communication about each staff member is kept up-dated
- Captures the Terms of Reference (key performance areas) of each staff-member as a basis for both self-evaluation and supervisor evaluation
- Is linked to a logging system for monitoring both punctuality and time at the place of work as a basis for remuneration
- Provides some of the data required for monetary and non-monetary performance awards.

3.4.2. Policy Statement

A computerised Human Resource Management Information System will be implemented in order to enhance and streamline the human resource management and administrative processes.

Essential functional requirements

- Plan short- and long-term staff requirements.

- Recruitment, promotion, and retirement of staff.
- Appraisals.
- Staff development.
- Salary administration (including tracking individual lecture hours)
- Staff welfares issues (insurance and medical, leave, etc.)
- Pension fund administration.

The following should be considered as key implementation issues for the Human Resource Management Information System:

- i. There is need for a clear Human Resource Policy that will guide the processes in the information system. It should particularly be noted that systems analysis and business process re-engineering that are a necessary step before computerisation will lead to a review of the organisational structure.
- ii. There will be need for liaison with the Finance and Accounting department regarding payment of salaries and other benefits with respect to the Payroll module.
- iii. There will be need for interfacing with the government of Cambodia who provide the bulk of salary payments

3.5. Executive Management Information System

The top management of the university, certainly the Rector and the Vice-Rectors of RUPP, will need to get reports that need to access data from all the different corporate and unit specific information systems that would have been implemented at the both corporate and unit levels. This might for example be looking at say correlations between the volume of research in a faculty and the performance of students; or an analysis of key factors that affect student performance; or per unit student costs in different courses; or indeed the different standard reports available from each information system. Top management need to be able to do this through a single log-on (managed through access levels) combined with the ability to run executive style reports that call upon all databases in the university.

RUPP will implement an Executive Management Information System to enable the generation of non-standard reports that are required from time to time by authorised users.

The main requirement of this information is that it enables a multiplicity of executive level reports as well as non-standard reports: these will need to be agreed by the RUPP top management at the time of implementation.

3.6. Cross-cutting Implementation Issues

3.6.1. Systems Analysis and Business Process Redesign

Manual systems that are currently the norm at RUPP are characterised by centralised and hierarchical processes because not everyone has access to all the information required to make

decisions. Computerisation brings the immediacy of access to the same consistent information to every member of staff, and is therefore an opportunity to rethink processes and make the organisation more efficient. RUPP will seize this opportunity for change to create a more efficient and more effective institution.

Second, there have been many information system failures for various reasons:

- i. The change process started off without a systems analysis and business process redesign; computerising inefficiency;
- ii. Owners of the system did not lead and inform the new processes;
- iii. Expectations are not managed;
- iv. No change management process, especially addressing mind-set, fear of the unknown; and fear of job losses

It is a policy requirement that before any information system is implemented, it will be a requirement to demonstrate to university management that there is a credible plan to mitigate or eliminate all these failure factors.

3.6.2. Architectural Conformity and Compatibility

It is a policy requirement that any information system implemented conforms to the RUPP architectural standards and is compatible with existing or planned information systems that conform to such standards.

3.6.3. In-house Development

It is the RUPP policy that in-house capacity, supported by external expertise as necessary, will be used to develop all the applications required by the information systems in order to build national expertise and also minimise the long term cost of ownership.

3.6.4. Mobile Platforms

RUPP recognises the ubiquity of mobile platforms and it is therefore a policy requirement to ensure that all user interfaces also provide for mobile platforms according to current technology.

4. End User Skills Development

While the assessment of the ICT environment at RUPP revealed that the majority of students and staff have sufficient ICT skills to fully exploit a computerised environment, the Stakeholders workshop expressed a concern about skills gaps that could marginalise groups of students especially from the rural areas. Secondly, functional staff in the different administrative systems that have been relying on manual or computer supported (but not automated) processes must be brought to a much higher level of competence. Finally, computerisation means that some employment cadres, especially those responsible for functions that can be automated, will find themselves without jobs: such people need to be retrained and redeployed in new functions within a revised organogram.

This Chapter provides the policy level requirements for end-user training.

4.1. Findings from the Stakeholders' Workshop

- i. Many lecturers lack the requisite ICT skills to be able to exploit for instruction as well as communication with students. Equipping lecturers with the necessary ICT skills is a necessary intervention.
- ii. There is a large knowledge gap between students from the city schools and those from the rural areas. There is need for a system of remedial classes to be run prior to the start of the university term.
- iii. Most users do not know how to find materials or use library resources, and the Library does not have enough staff to help everybody, including reference consultation services. There is need for an easy to follow step-by-step guide that users can work through on their own.

4.2. Policy Statement

In an environment where pedagogic, administrative and managerial processes are automated, the necessary skills to utilize the services/systems, keep them running, and develop and implement them demand new, often high-level, skills. End-user skills development includes all efforts to enforce awareness, general knowledge and general and specific computer skills related to the use of information technology. Within this context the end-user is defined as each person who uses ICT services or the information they produce to support their learning, teaching, research, administrative, or managerial tasks.

RUPP will implement on-going training programmes that ensure that all students (during their first semester) and staff (during the first three months after recruitment) have the requisite awareness and skills to work effectively in their assigned function in a fully online environment.

4.3. Key policy level requirements and drivers

The following are university policy level requirements:

- i. ***In order to ensure that each student has sufficient cross-cutting ICT awareness and literacy to exploit an e-enabled learning environment, there will be pre-tests to identify those who need training, and such students will be provided with opportunity to take the prescribed training module(s) within their first semester in the first year. Such modules may carry***

credit towards the graduation requirements. The required ICT awareness and literacy levels will be set by the university from time to time.

- ii. The university will from time to time set the ICT skills for different levels of staff; and all staff shall be required to demonstrate the required ICT skills for their level before formal appointment. For a transition period of three years ending after adoption of this policy, training will be provided to continuing staff that do not have the requisite ICT competence to build up the necessary skills. During the same period, new staff will also be provided with such training within the first three months of employment.*
- iii. Before appointment to lecturer level, the academic staff will be required to demonstrate the prescribed level of competence in ICT-enabled interactive learning techniques. Staff already at or above this level will be required to acquire the prescribed competence by the end of 2019.*
- iv. There will be specialised training for the different categories of end-users that need to interact regularly with the major information systems aimed at attaining higher levels knowledge and skills so that they are able to:
 - a. Use ICT services and systems effectively and as independently as possible.*
 - b. Contribute to the specification, design and implementation of ICT applications.*
 - c. Be aware of the shared responsibilities for equipment, software and data, and enforce an atmosphere of collective responsibility and system ownership.*
 - d. Manage and control complex project oriented processes, like implementing University-wide infrastructure or information systems.*
 - e. Establish and sustain effective, efficient application and data management and systems maintenance.**

Content and level of training for the different target groups will be in line with the actual training needs, arising from the implementation of the different ICT services and systems.

- v. RUPP will ensure that the necessary organizational (trainer capacity, training management) and technical (practice lab and computer based training tools, self-paced training mode) conditions environment is implemented to ensure continuing in-house ICT training capabilities.*
- vi. All communication and notices within the university shall be required to be in soft form once institutional email addresses are issued to all staff and students.*

5. ICT-Enabled Learning and Research

ICT-Enabled Learning and Research in this context refers to any learning methodology where ICT is used to enhance effectiveness. At the lowest level, ICT can be used to enhance the effectiveness of traditional approaches to learning – allowing electronic presentations, animated demonstrations, simulations, computer driven experimentation, communication and collaboration, etc.

At the higher level of application, there is E-learning where the lecturer is just one of the resources in an online student-centred interactive learning environment. E-learning creates both opportunities and challenges, and therefore needs to be approached with full awareness of each so that the environment is shaped to ensure success. It should be especially noted that e-learning is not just about placing the usual lecture notes or courses online: it calls for a completely different pedagogical approach and will mean increased workload on staff especially in the transitional period (which in turn requires motivational factors to be incorporated). E-learning enables students not located at the university to access both resources and instructors from wherever there is good Internet access. This can be exploited to increase enrolment without straining physical facilities.

5.1. Findings by the Stakeholders' Workshop

- i. Students come from a background of simply being taught without any culture of self-learning or research. There is a need to address the attitude of students to learning through appropriate pedagogic approaches so that appropriate curriculum design.
- ii. The large numbers of students in each course makes the marking and assessment of assignments, through which students are supposed to get feedback and improve, very difficult. There is a need to introduce and implement methods of learning and assessment that make the management of large numbers easier
- iii. The research and instruction environment is limited by the lack of research facilities including laboratory equipment and associated laboratory applications.
- iv. Lecturers are not trained in pedagogy: being good at a subject does not mean one has the ability to give instruction in that subject. There is need for interventions that equip lecturers with an understanding and application of teaching skills.

The challenges in Teaching and Learning point to three major areas where they can be addressed: A computerised Academic Management Information System that handles admissions, registration, time-tabling, and tracking of performance and graduation, all designed to take into account the specific challenges and policies in Cambodia (addressed in Section 3.2); An E-learning Policy (separate from the ICT Policy) that will be the basis for addressing some of the challenges; and a Research Policy that ensures that RUPP recognizes and puts focus on research as a critical component of any world-class university. Once the Research Policy is in place, it will require the implementation of a Research Management Information System.

5.2. Policy Statement

The entry point for RUPP will be the lowest level that can then be transitioned over time to real e-learning. A pre-requisite for E-learning is a clear E-learning policy that looks at the full eco-system, most of which has nothing to do with ICT. The elaboration of such a policy is beyond the scope of

the ICTP/MP. Research also faces the same challenge in that a pre-requisite is a holistic Research Policy that will then lead to a Research Management System. The elaboration in this document therefore addresses two policy aspects: implementation of ICT-enabled learning and research at the lowest level, and beginning to create an ICT-enabled environment that will support early adopters. This policy however makes specific reference to the development of both the formal E-learning Policy as well as the Research Policy so that the development of these and the implementations implications for the ICT-enabled environment are taken into account during the life of this ICTP/MP. This recognises the reality that transitioning RUPP to e-learning and a strong research base will require many enabling changes as well as time.

RUPP will improve the efficiency and effectiveness of learning and research by:

- i. Modernising all lecture rooms to ensure that they are suitable for both traditional and collaborative online learning methodologies***
- ii. Modernising all labs to enable, where needed, computer-driven experimentation and simulations as well as access to remote labs;***
- iii. Retraining lecturers to understand the advantages and limitations of e-learning using student-cantered self-led learning approaches, including content preparation, discussion mediation, and grading;***
- iv. Establishing a rewards system that recognises the demands of online learning***
- v. Implementing a locally hosted E-learning System to enable use by early-adapters;***
- vi. Developing and implementing a holistic E-learning Policy***
- vii. Developing and implementing a holistic Research Policy and a Research Management System***

Modernising refers to the provision (for each lecture-room or lab as appropriate): computer networks for use by students, as needed, for online learning and collaboration or controlling experiments; networked projectors; and smart boards and/or screens; video conferencing facilities. It also includes the provision of the necessary back-end facilities (connectivity, applications, servers, databases, etc.).

6. Network Infrastructure and Services Policy⁶

The network infrastructure of RUPP University is defined in this document as the physical components that form the backbone (regardless of technology) on which all anticipated ICT services should run. The basic network services are those expected on provision of any standard university ICT infrastructure (for example email services and intranet applications). The objective is to ensure a consistent and integrated design that assures a high level of availability while minimising costs of operations and maintenance.

ICT technology evolves rapidly, and this document therefore avoids recommending specific technologies to the extent possible. It rather focuses on desired functionality, leaving technology decisions to be taken at the time of implementation.

6.1. Findings from the Stakeholders' Workshop

There are cross-cutting challenges related to:

- Communication among or between staff and students
- Communication outside RUPP
- Accessing internal resources (Library, Time-tables; Circulars; RUPP web pages; general information; etc.)
- Ease of access to online resources as well as communication with the external environment

There is need to address all these and more through the establishment an Intranet along with an inclusive campus mail service and up-to-date web pages, and also as a portal for accessing other information systems as they come on line. Pervasive and high speed access is required across all RUPP campuses as well as to the external environment through a robust campus network and sufficient external bandwidth.

6.2. Policy Statement

RUPP shall:

- i. Ensure access by all students and staff to common network services by implementing an Intranet consisting of: a single access portal to all university online applications and services; and intra-campus networks on all campuses as well as inter-campus connectivity utilising technologies that are forward looking and also ensure that all staff and students can get access to unlimited bandwidth for intra or inter-campus level applications and communication anywhere on the campuses. For clarity, unlimited in this context means that bandwidth should never be a constraint for education, research, administrative, managerial and collaboration applications that run on the university intranet.***

⁶Some of the general policies and infrastructure descriptions as well as sub-policies used here have been used by the author elsewhere since infrastructure policy and functionality is not necessarily institution specific.

- ii. Ensure that all students and staff have access to high speed broadband for national, regional, and international education and research collaboration and communication. “High speed broadband” here is defined as having the key attribute of “always on”, and in addition having download and upload speeds that are equal to or better than the national definition of high speed broadband. RUPP will specifically play an active role in the national research and education network of Cambodia in order to promote national, regional and global connectivity and collaboration.*

The derived policies detailed below are aimed at achieving the objectives of these high-level policy statements.

6.3. Network Infrastructure

Network Infrastructure has the following specific elements:

- i. A campus backbone network linking all buildings on the two University campuses.
- ii. Inter-campus links between the two campuses
- iii. Routing centres/equipment at the core and access levels of the backbone network.
- iv. The Data Centre
- v. The Network Operations Centre (NOC)
- vi. Local Area Networks (LANs) within the various buildings and access locations
- vii. Campus wireless coverage (Wi-Fi or other)
- viii. Computers and related accessories for students and staff

RUPP has two campuses of: Campus 1 the main campus, houses sciences, education, engineering, development studies, and foreign languages. It also houses all the administrative offices. Campus II houses Social Sciences and Humanities. The main campus hosts approximately 80% of the University buildings, which include administrative, academic and residential (students and staff).

Figure 2, Figure 3, and Figure 4 show views of the two RUPP campuses, Campus 1 (Main Campus) and Campus 2 respectively as well as the building sizes for Campus 1. As can be seen, both are quite compact and do not present a major challenge in terms of the implementation of high bandwidth campus networks (both wired, and wireless) targeted at anywhere access as well as mobility of users). Wireless access is also made easy by the generally flat topography.

3D Map of Royal University of Phnom Penh

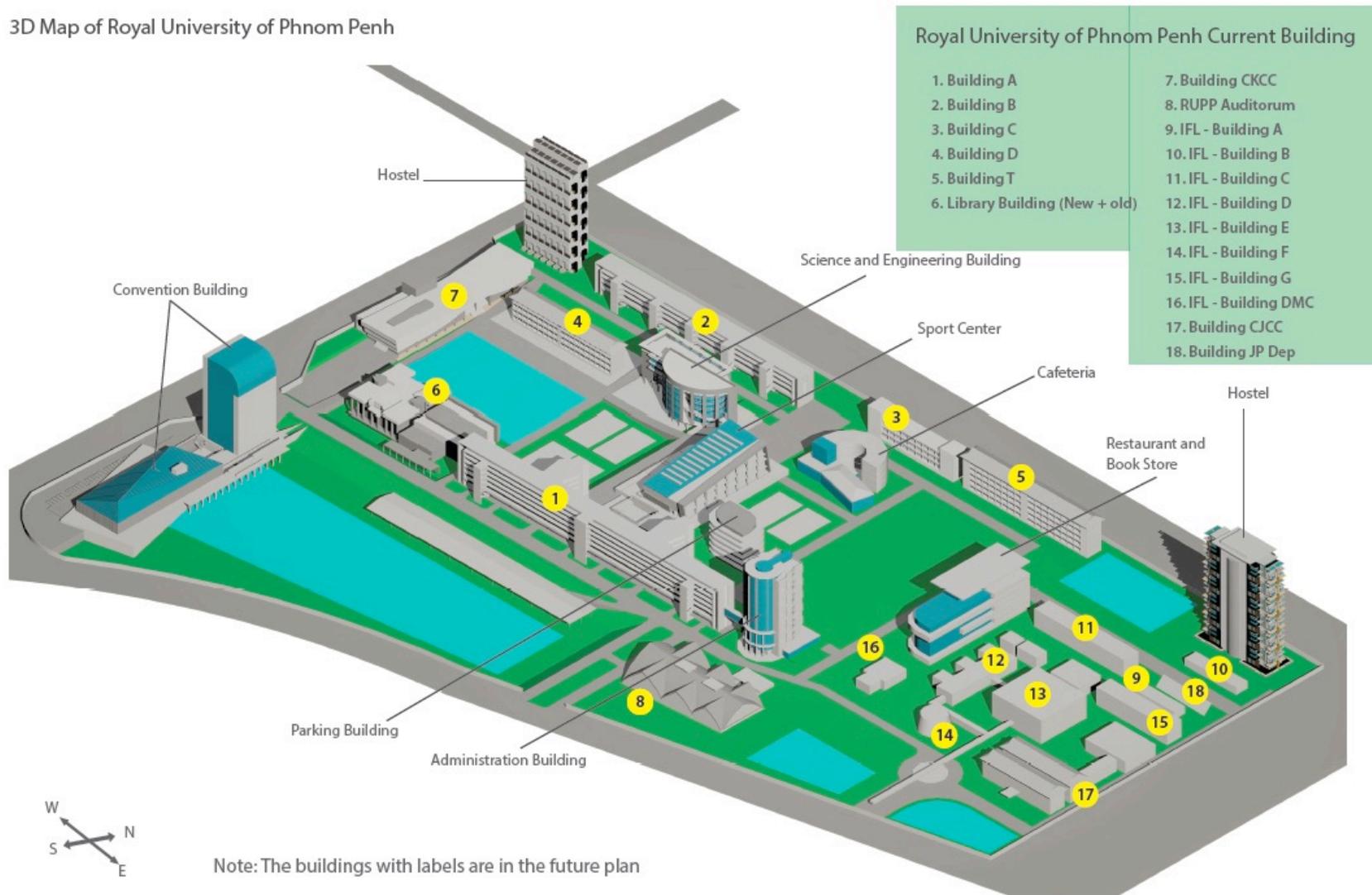
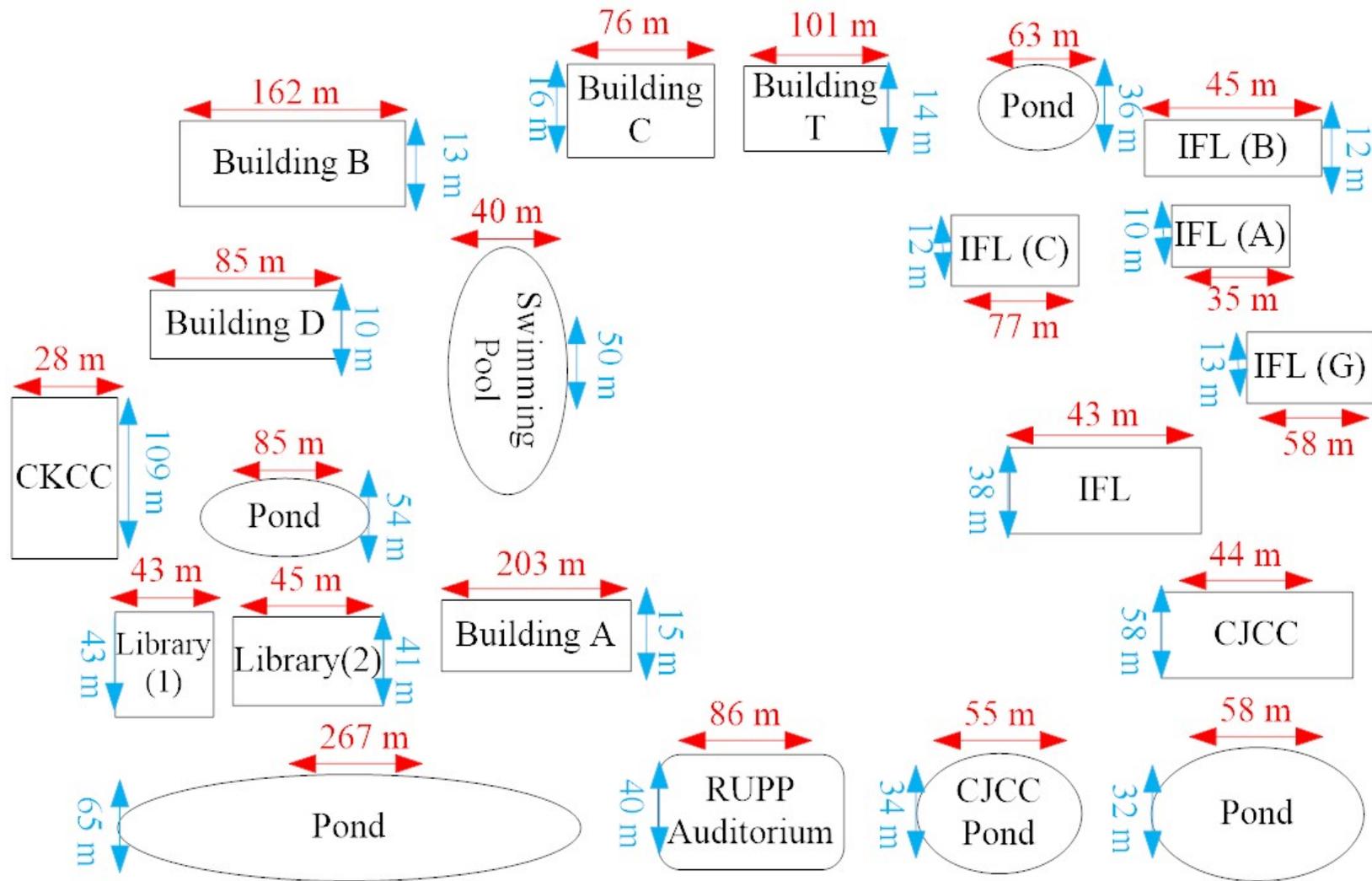


Figure 2:RUPP Campus 1 (Main Campus) 3Dmap



Figure 3: RUPP Campus 2 map



ix.

Figure 4: RUPP Campus 1 (Main Campus) building sizes

6.3.1. The Campus Backbone

It is the University policy to provide reliable and sufficient access to central ICT services and systems through the implementation of campus-wide broadband backbone network linking all buildings on the two campuses.

- i. The backbone network shall use technologies that meet the current bandwidth capacity needs and provide for service growth demands with minor disruptions to existing infrastructure.
- ii. The design of the backbone shall be such that any future upgrades do not require an overhaul of the existing infrastructure but preferably replacements of components thereof.
- iii. The network backbone architecture shall provide for as few failure points as possible. The preference shall therefore be for fewer active nodes (routing centres) at the cost of longer fibre runs. While this design has higher capital costs, the lower long-term operational expenses far outweigh this. The type of technology option selected shall determine whether the infrastructure is underground, overhead or a hybrid.
- iv. The design shall provide for path redundancy such that a physical failure on one route does not shut down the entire network backbone.
- v. There must be full conformity to required installation and safety standards

When the underground infrastructure is the preferred option, the design shall take into consideration the following:

- a) The infrastructure Master Plan of the University to ensure that cable, where used, is not routed through locations where disruptions and maintenance shall become a future challenge.
- b) Cables shall be routed through ducts with concrete overlays and warning tape. The ducts shall be water and rodent-proof.
- c) Allowance shall be made for inspection access chambers or boxes (within the backbone and at building entrances) to allow for ease of maintenance and upgrades.

When overhead infrastructure is used, the following shall be considered in the design:

- a) Environmental factors (aesthetics): It shall be preferred to run cables along existing cable infrastructure (say power lines)
- b) For wireless technologies, the frequencies utilized shall be standard (national and international) to assure non-interference.
- c) Implementation of radio links shall as much as possible avoid environmental degradations (like cutting of trees for line-of-sight links).

6.3.2. Inter-campus Links

The University shall make provision for interlinking the two campuses with a capacity that ensures that they are virtually in the same location. The planning minimum interconnection capacity will be at least 10Gbps, fully protected.

6.3.3. Routing Centres/Equipment

All active devices (core and access) on the network shall be housed in equipment rooms appropriately located as per the backbone cable routing. The following guidelines provide a basis for design and implementation:

- a) All cabling within the switching and routing centres shall terminate in standard patch panels installed in cabling racks.
- b) All equipment shall conform to open standards to allow for inter-operability of various vendor products. It shall however be a preference for the University to use a given product range to benefit from the vendor support and network management features that come with a single vendor solution. Additionally, this shall contain technical training and maintenance costs.
- c) To avoid network outages and failures, all equipment shall be powered through Uninterruptible power supplies and generator back-up appropriately sized to sustain autonomous operations for at 72 hours.
- d) To allow for a long lifetime of equipment, standard HVAC designs be adhered to ensure that the right environmental conditions are maintained within the rooms.
- e) For ease of maintenance and troubleshooting, the link terminations for the individual networks shall be uniquely identifiable within at the switching centre level.
- f) For optimal space utilization and operational management, the Policy shall have preference for rack mount equipment where ever possible. Desktop kind shall always be the exception.

6.3.4. The Data Centre

The Data Centre will house all the servers, routers, and all associated hardware for central services, and may in addition house servers for databases and applications for non-central services (solely used by particular academic or administrative units).

The Data Centre shall be located and designed to ensure: physical security; minimum ingress of external heat while at the same providing for easy air-conditioning; and 24x7 power autonomy in the event of a mains power outage. All guidelines for routing centres as described in Section 6.3.2 shall apply to the Data Centre with the additional requirement of a properly sized generator to assure the required 24x7 availability in the event of extended mains power outage.

The University shall establish a Disaster Recovery Centre (DRC), providing spatial redundancy for the NOC. The DRC shall be equipped and configured to ensure that all services and applications considered critical are able to continue seamlessly in the event of a complete outage of the Data Centre. The DRC shall specifically provide complete online backup of all databases.

6.3.5. NOC

The NOC shall be a purpose designed room where technical staff can monitor and control the entire RUPP network, network services, and applications. The NOC may be located immediately next to the Data Centre in case the latter experiences a fault that requires physical intervention.

6.3.6. Local Area Networks

Local Area Networks (LAN) shall be implemented in each building in a way that ensures that all users or residents can get wired or wireless broadband connectivity while in the building. The preferred option (wired or wireless) shall be guided by the service being provided and its required functionalities. Wired technologies shall be preferred for location specific access and higher security requirements. This shall be particularly so for the server side. The mobility and lower cost per unit offered by the wireless technologies shall be optimized for user access particularly within residences and other work spaces where cabling is not a viable option.

All implementations shall adhere to industry standards for building cabling and wireless technologies

6.3.7. Campus Wireless Coverage

All RUPP campuses will be blanketed with broadband wireless connectivity (using Wi-Fi or other technology) to assure “anywhere access” for students and staff.

6.3.8. Computers for Students and Staff

The university policy is to encourage personal ownership of computers by students and, to the extent possible or practical, by staff.

Universal ownership or access to communication and computing devices is a necessary precondition both for successful integration of ICT in all functions and motivating acquisition of individual skills.

- i. **RUPP will develop a programme in collaboration with the government of Cambodia or other willing entities to set up a financing/loan scheme through which students and staff can acquire their own computers.**
- ii. **The university will in addition provide for individual and shared access using university-owned equipment to ensure that:**
 - a. **Each undergraduate student who does not have a personal computer yet can access online resources for at least five hours each day;**
 - b. **Each graduate student or each member of academic staff can get access to online resources on a full time basis;**
 - c. **Each member of administrative staff has access to a computer either on a full time basis, or for shorter times as dictated by the functions of their offices.**

For general student access, the University shall set up common student computer labs, and academic units will also be required to provide additional facilities.

6.4. Network Services

Two initial categories of services will be rolled: Internet access and Intranet services.

6.4.1. Internet access

The university will provide ubiquitous Internet access at all network locations on the University on a 24-hour basis per day.

It is the university policy to use the Cambodian Research and Education Network, CAMREN, as the provider of Internet Access Services subject to their (CAMREN) being able to provide a protected service and the required service levels at a competitive price. It is however recognised that CAMREN is not yet fully operational: RUPP will in the interim procure Internet Access from the commercial sector.

To optimize bandwidth utilization, the University shall implement bandwidth management tools and security measures (e.g. firewalls, filters) to manage usage. Additionally, the university shall promote use of intranet services (e.g. corporate mail, file backup, chat) to ensure that unnecessary traffic is kept off the Internet link.

6.4.2. Intranet Services

An Intranet shall be implemented to enable provisioning of various services that include the university web pages; corporate email services; user authentication; central file storage; directory services; news and announcements; etc.

Web pages:

There will be three categories of permitted web pages: corporate (main university web pages), faculty/department, and private. For consistency of the university corporate image, all corporate and faculty/department web pages shall be required to conform to the appearance and standards defined by the university. RUPP shall designate editorial responsibility for the corporate web pages to a specific office (possibly the public relations office?). The respective units shall take responsibility for their content.

Email services:

- a) The University shall implement a corporate email system supporting internal and external communication for all students and staff. The service shall provide both web and POP access anywhere anytime. The functionality offered by the service shall be benchmarked against the commercial alternatives to ensure that users take it on as a competitive option.
- b) All staff at RUPP will be assigned institutional email addresses, and it will be an enforced requirement that all outgoing email from the university intranet originates in a university assigned email address. Each new student shall be assigned an email account at registration, which shall expire one year after leaving the University: such addresses must be used for all email originating from within the intranet.
- c) The University shall draft an email use policy that will provide 'acceptable' guidelines, which all users shall subscribe to. This will address inappropriate and illegal use issues.

Central authentication service:

Access to all network services shall be through a central authentication system that shall query a user database (the students and staff databases). This shall be a single sign on system for users providing access to all network and information services offered by the different functional units of the University (Library, Academic, Finance, Human Resource, etc.).

Central file storage:

A central file storage solution shall be implemented to address both server side and client storage needs. Standard storage capacities shall be defined for different categories of users. This capacity shall be availed at initial sign on and will remain effective until a year after leaving the University. All data for the server side shall be hosted on this central storage system (Storage Area Network or Network Attached Storage) and effectively backed up at a mirror site.

6.4.3. Anti-virus Solution

The University shall implement a corporate anti-virus solution that will provide an automated updating function on all computers within the university. The solution shall ensure minimal user intervention and should provide for a monitoring functionality.

6.5. Security Policy

The growth of external access bandwidth and the improvement of intra-university bandwidth, combined with a computerisation of all RUPP functions, will rapidly multiply the cyber-security threats, both internal and external. What is outlined here is not the Security Policy, which needs to be developed as a separate document, but rather a set of initial steps to secure the university ICT resources. The main purpose of a security policy is to inform and guide users, staff, and managers of the requirements and their obligations in protecting technology and information assets. Security is not an activity that is over once it is done right the first time. Rather, it is an iterative process, continually improving on what already is being done and what has been done: it must be part of the university culture. Implementation of security measures is not organized as a project, but as a permanent set of tasks integrated in the Information Resource Management function (Chapter 7).

The following are the basic requirements for securing network resources:

- a) Ensuring that only authorized individuals have access to information.
- b) Preventing unauthorized creation, alteration, or destruction of data.
- c) Ensuring that legitimate users are not denied access to information.
- d) Ensuring that resources are used in legitimate ways.

The following measures shall be taken as part of ensuring security:

- i. Encrypted communication methods where applicable will be used by university critical systems (e.g. financial, student databases and so on).***
- ii. A security policy will be put in place to ensure continuous threat analysis and ensure patches are applied to operating systems as it becomes necessary.***

- iii. Intrusion detection systems, vulnerability scanners and firewalls will be installed in order to detect unauthorized network access and hostile network traffic.*
- iv. Anti-virus software will be installed in mail servers to ensure mail is scanned as it enters or leaves the university network.*
- v. Passwords to critical systems will be changed after a fixed period of time in order to prevent password cracking and unauthorized access.*
- vi. A backup scheme and off-site storage strategy will be put in place to ensure availability of good data in case of data corruption.*
- vii. Physical security (Burglar proofing, electronic access cards) will be implemented in all backbone points and computer Labs*

7. ICT Management Policy

As earlier discussed, the integration of ICT in RUPP must be driven by the vision and strategic priorities of the university. It should also be noted that the integration of ICT in all the university functions is going to affect the way all staff and students in the university work and interact, and will, if not properly handled, create a lot of resistance that can delay implementation or indeed cause it to fail. This then requires that a high level forum is created involving the top leaders of RUPP as well as representatives of key stakeholder groups (taking into account the provisions in the RUPP governance policies) to set and monitor the direction and pace of implementation, provide policy level monitoring and evaluation, and also ensure the allocation of sufficient resources. Stakeholders include management, students, staff, and may also include alumni. At an operational level, there will be operational issues that will call for joint agreement about architecture among the key functional units of the university.

RUPP will also increasingly rely on the availability of ICT services and systems – and these will become mission-critical over the next few years. It is therefore also important that there is a dedicated unit manned by a sufficient number of staff with the requisite qualifications to assure availability of the services and systems. The collection of organizational arrangements needed to assure appropriate management and maintenance of the university's ICT resources and professional user support that will be handled by this unit is called Information Resource Management (IRM): It is a positive start that RUPP already has an established unit for IRM, the IT Centre (ITC), providing a good starting point.

This Chapter details university policy that describes the ICT management and operational environments, along with the core functions of ITC.

7.1. Findings from the Stakeholders' Workshop

The Stakeholders Workshop, in plenary, re-emphasized the following findings, most specific to ITC, from their earlier input during the assessment of the ICT environment:

- i. The ITC is very limited in terms of equipment and other tools for rolling out, and for management, control, and maintenance (MCM) of the ICT resources.
- ii. The ITC staff is still limited in terms of both exposure and specialised skills for MCM of a modern data communication network. They for example have good insights into what AR, Finance and HR systems would be like, but clearly need to understand the issues better, and to have the line departments involved a lot more in defining functionality. Another specific area of skills needs is specific to the design, rollout, configuring, and operating advanced data networks.
- iii. Salaries paid to ITC staff are very low, forcing them, like the rest of the university community, to look for other means of making ends meet. The availability and reliability of comprehensive modern ICT services and systems in an institution the size of RUPP will require the full-time and undivided attention of all ITC staff.
- iv. There appears to be limited awareness among decision makers who control the budget, who are all external to RUPP, about the benefits of ICT in enabling achievement of the RUPP

vision, mission, and strategic objectives. We have observed that this could be a challenge of packaging and communication of the message from RUPP.

- v. The person heading ITC should report to the Vice-Rector, Academic Affairs, and through the office to the Rector.

7.2. Key Policy Statements

RUPP shall:

- i. Implement an ICT governance environment that ensures that all stakeholders have a say at the appropriate level in determining the functionality, specification, and service levels of all ICT services and systems***
- ii. Establish/sustain a specialised ICT Support Unit responsible for the management, control and maintenance of ICT systems and services to ensure the availability to users at the agreed service levels***
- iii. Ensure that ICT services and systems are sustainable by:***
 - a) Allocating sufficient financial resources, combined with an ICT Fee chargeable to every student, to cover, as a minimum, the recurrent costs of all ICT services and systems and also provide for growth and continuing modernisation;***
 - b) Ensuring that the ICT Support Unit is staffed with a sufficient range of human resource and skills combined with remuneration that recognises the reality that RUPP has to compete with the private for the kind of technical human resource that is able to ensure availability of ICT services and systems at the required service levels.***
 - c) Using acquisition policies (for example local development wherever possible as opposed to buying proprietary systems; university-wide open source policies; etc.) that minimise recurrent costs while also building local capacity;***

7.3. Governance and Operations

7.3.1. RUPP ICT Committee

The RUPP ICT Committee shall be established to be responsible for the following functions:

- a) Monitor and control the progress of all activities arising from the implementation of the University's ICTP/MP;
- b) Allocate resources according to the agreed master plan;
- c) Ensure that all project implementation plans comply with policy requirements, including addressing change management, sustainability, and monitoring and evaluation
- d) Review and approve budgets for implementation, management, operations, maintenance and expansion and follow up approval through the university budget;

- e) Recommend proposals for sustainable funding
- f) Determine/approve ICT Policy adjustments arising from organisational changes (including any changes in Vision or Strategy) and technology

The RUPP ICT Committee will consist of the following:

- Rector (Chair)
- Vice Rector Academic Affairs (Vice-Chair)
- All other Vice Rectors
- Office responsible for Planning and Development
- A representative Dean of a faculty from the sciences side
- A representative Dean of a faculty from the Arts side
- Director, ITC (Also the Secretary to the Committee)
- Student Representative
- In Attendance at Meetings: The Heads of the 4 major functional units, viz. Accounting, Studies, Personnel and Library

7.3.2. Architecture Working Group

There will be established an Architecture Working Group (AWG) composed of Deans of faculties, heads of functional units, and student representatives. This will provide a forum for the development and continuous review of the University's information architecture, ensuring that it conforms to the common vision of the end users. The AWG will be a change driver, providing inputs for the IRM Unit and the University ICT Committee. The AWG will be chaired by the Vice Rector, Academic Affairs, and the IRM Unit will provide the secretariat.

7.3.3. RUPP University Information Resource Management Unit

The Information Resource Management Unit has already been established at RUPP as the IT Centre (ITC). The primary tasks of this unit/department are management and maintenance of common ICT systems and End-user support. All necessary functions/skills for day-to-day management of *all* ICT resources and user support services will be gradually developed during the five years starting with a review of the structure and functions of the current unit to ensure that they are in conformity with the ICTP/MP.

The status of the head of ITC must align with the role that ICT plays in the university. He/she is involved in the strategy-formulation process of the institution. In an institution for higher education, where ICT has strategic importance, a low-status ICT manager (low-status in reporting level and/or compensation) has difficulty getting the necessary information from general management level in the strategic planning process and aligning ICT policies with the vision of general management and general strategies. *ITC will therefore be managed by an appropriately skilled manager who will report to the Vice-Rector Academic Affairs and through that office to the Rector. Connection to these high levels is critical because of the cross-cutting nature of the duties of the unit, affecting all academic and administrative units of the university.*

Decentralization (distribution) to faculties and administrative departments of certain ICT management tasks may be considered. Decentralization should only take place if feasible, and cost-effective. Decentralization will be approved by the ICT Steering Committee.

For each ICT resource (computer, data communication device, software, network components, and data storage) an “owner” will be defined. Ownership of specific ICT resources will be determined by the university’s general management. Ownership of common ICT resources (e.g. communication infrastructure, general services) will be delegated to the IRM Unit.

7.3.4. Service Levels

Service levels quantify the performance and availability of ICT services and systems, and provide a basis for contractual relationships between the user units and ITC that will drive performance. Service levels of ITC Unit will be determined in line with the ICT services/systems provided and related service level requirements.

7.4. Core ICT management functions

The core ICT management functions that ITC are responsible include, but are not limited to the following:

- i. End-User Support Services
- ii. Operating Systems and Network Management
- iii. Systems and Database Administration
- iv. Configuration Management
- v. Security and Auditing Services
- vi. Technology Planning

7.4.1. End-user Support Services

End user support services cover advice and support in all matters associated with access to and use of network infrastructure and various ICT services.

A central Help Desk function will be established as a point of contact for all users and will be the point of access for all general and expert services provided by ITC. This will be staffed by personnel who can give immediate support or can refer users to specialists as part of the Help Desk System. The Help Desk function shall be fully computerised.

The following major categories of services will be provided:

- a) Assistance for day-to-day end-user computing problems.
- b) General technical assistance, focusing mainly on guidance (e.g. selection and procurement of ICT resources, selection and evaluation of application packages and other special purpose software, software installations and updates, assistance in using query and reporting tools, hardware installations, communication devices installation and use, security, etc.).
- c) Expert support and interventions (systems analysis and business process re-engineering; developing new applications; security and security audits; sub-network designs and installations; etc.).

The central helpdesk, headed by a competent full time person, will act as the focal point for all problems, questions and incidents and will be responsible for dispatching of incidents to the technical specialists. Relevant posts in this organisational unit are: End-user Liaison, Office Automation Specialist.

7.4.2. Operating Systems and Network Management

These functions deal with the day-to-day operations of all servers and all active as well as passive network devices cabling systems of the data communication network. This includes responsibility for acquisition and maintenance. The major tasks are:

- a) Monitoring and tuning the performance of all components of data processing systems as well as data communication equipment.
- b) Monitoring and controlling server capacities and communication throughput (particularly important for online remote transaction processing).
- c) Analysing capacity and performance statistics and forecasting computing, storage and communication capacity.
- d) Execute and/or guide preventive, corrective and perfective maintenance of operational hardware as well as software.
- e) Acquisition and installation of new or additional equipment and software (qualitative and quantitative upgrades).
- f) Installation and maintenance of security systems and technical facilities such as climate conditioners and power supplies.

Two senior full-time responsibilities, systems management and network administration, are associated with these functions. The two must work in close collaboration.

7.4.3. Database Administration

This function will deal with the planning, procurement, programming, administration, and management of both corporate and unit-specific databases, database systems, and the database servers in order to assure quality, accessibility, and security of data.

Since data is a corporate resource, database administration is a full-time high-level function with responsibility for determining and co-ordinating data resource management from policy to implementation.

Database administration has both co-ordinating and technical oriented tasks:

- a) Definition and promotion of database standards.
- b) Promotion and control of data sharing.
- c) Analysis of impact of change requests (for example: data definition changes) to applications.
- d) Maintenance of the data dictionary and other documentation.
- e) Reduction of redundant data and data processing.
- f) Improvement of use of data (by promoting Database Management Tools and Query Languages).

- g) Improvement of security of data (designing and implementing proper procedures to recover from damage of data, and designing measures and procedures to protect and secure data)
- h) Tuning database management systems.
- i) Selection and evaluation of database technology (database management software and media).
- j) Physical placement of databases on servers.
- k) Installation of (new releases of) database management systems.
- l) Development of interfaces of databases with telecommunication.

7.4.4. Configuration management

Configuration management covers a wide range of administration tasks. ITC shall maintain and manage a database that contains all information about the configuration and interconnections of: workstations, servers, data communication equipment, I/O peripherals, etc., along with all software characteristics and access rights and arrangements. System and network managers can refer to this information when they need to change the configuration or determine or analyse the cause of some failure.

7.4.5. Security and auditing services

This concerns access to service/applications and electronic data stores located in network nodes throughout the institution. Security management is required to ensure that access to these services and data is controlled (authentication) and authorized. Further data integrity and data privacy must be ensured. Security procedures shall be subject to regular audit and review.

7.4.6. Technology planning

ITC shall be responsible for the continuous evaluation of new and emerging technologies in order to guide different units as well as the university about potential opportunities of enhancement, as well as risks of obsolescence.

7.5. Make or buy policy

For each ICT service or application, the university management will take the decision whether it should be developed 'in-house' or acquired from external sources based on the following key considerations.

Key factors that favour the *make* decision include the following:

- A customized ICT application or service that is totally responsive to the institution's very specific needs.
- Increased ease in developing software due to the growth of Rapid Application Development tools and systems.
- Ease of adapting software to rapidly changing user needs without having to co-ordinate the requirements with vendors.

- Developing professional competence in software development.

Key factors that favour the *buy* decision include the following:

- Ability to gain access to specialized skills that cannot be retained or for which there is insufficient need to have continuously available.
- Cost. Building software is still extremely costly.
- Staff utilization.
- Ability to make short-term commitment for ICT development support instead of having to make major investment in staff recruitment and professional training.

8. Change Management

ICT services and systems, especially the information systems, pose major failure risks because they are built around new policies, processes, and procedures that displace antiquated manual environments. The use of ICT in information systems enables and requires a distribution of decision making and a flattening of organisational structures because all staff now have access to the same information and data online. It also creates organisational transparency because a much larger number of people can get access to all information about the organisation. An inevitable consequence is that the old power relationships are disrupted; people's jobs are affected; and entrenched interests side-lined. The result is internal effort, normally presented in very rational terms, to slow down change and where possible stop it. To minimise the likelihood of failure, change management processes must therefore be part and parcel of the integration of ICT in all functions of RUPP.

8.1. Key Policy Statement

It is a requirement that before any project implementation plan is rolled out, it must be demonstrated to have convincing plan for change management in order to maximise the likelihood of success and reduce the likelihood of failure. The change management plan should as a minimum address the following:

- a) Creating awareness among functional staff and end users about the planned changes and their motivation, addressing both institutional and individual benefit;***
- b) Ensuring that ownership among all stakeholders is created through their involvement in conceptualisation, planning, and implementation;***
- c) Explaining the consequences of what was being done with respect to the day to day functions of especially staff, and incorporating what will be done to ensure that staff is not negatively impacted by the changes (training, re-skilling, transitioning new job assignments, incentives and benefits, etc.);***
- d) Explaining the stakeholders' roles in ensuring success along with the basis for evaluating success and how this will be done; and***
- e) Mainstreaming recurrent and obsolescence costs in the university budget.***

8.2. Responsibility for Change Management

The Office of the Rector will take overall leadership responsibility for Change Management related to the integration of ICT in all RUPP functions. As part of implementation, the RUPP ICT Committee will review all project implementation plans to confirm compliance with the change management policy before approval.

9. Monitoring and Evaluation

In the introduction to the key policy statements in Chapter 2, it is stated that “RUPP shall establish an environment where ICT can be sustainably exploited to improve connectivity and common network services; learning and research; university management and administration; as well as governance, management, control and maintenance of ICT resources guided by the following policy statements”.

It is important to set up indicators that demonstrate that there is progress towards the desired outcomes, and that this progress is achieved to a level that justifies the investment. Secondly, monitoring and evaluation is a critical on-going activity in any major implementation because it enables adaptive changes at first, the tactical level, and second, the strategic level to ensure.

The integration of ICT in any institution is also transformational, leading to changes in behaviour and expectation. This demands that other than the short to medium term tactical and strategic changes respectively, there will be continuing need for review of the major policies and strategies to ensure alignment with evolving user expectations as well as new technology opportunities.

9.1. Key Policy Statements

- i. It is a requirement that at the overall ICT Project level, output, outcome and impact level indicators as well as the methods of measurement are identified and base line values established as a starting point for setting and tracking institutional level targets, as well as adaptively adjusting tactics, strategies, and policies. These will be reported on annually, and the five-year ICTP/MP shall regardless be reviewed on a rolling basis at least once every two years.*
- ii. It is a requirement that each sub-project design incorporates a monitoring and evaluation plan that incorporates indicators as well as the methods of measurement at the output, outcome, and impact levels; and also enables tactical or where needed, strategic adjustments.*

9.2. Responsibility for Monitoring and Evaluation

The Office of the Vice-Rector Academic Affairs, as the administrative home of ICT integration in RUPP, will take overall responsibility of the Monitoring and Evaluation function. As part of implementation, the RUPP ICT Committee will review all project implementation plans to confirm compliance with the monitoring and evaluation policy before approval. The RUPP ICT Committee will also receive and consider the monitoring and evaluation reports and recommendations.

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