UNIVERSITY OF RWANDA

Information and Communication Technology (ICT) Policy and Master Plan 2017/18 – 2021/22

Part 2: ICT Master Plan Phase 1

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Abbreviations

Term	Description
AWG	Architecture Working Group
RwEdNet	Rwanda Education Network
DNS	Domain Name System
DRC	Disaster Recovery Centre
DSL	Digital Subscriber Line
ERP	Enterprise Resource Planning
Gbps	Gigabits per second
HVAC	Heating, Ventilating and Air Conditioning
ICT	Information and Communications Technology
ICTC	ICT Center
ICTP/MP	ICT Policy and Master Plan
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
NOC	Network Operations Centre
NREN	National Research and Education Network
Mbps	Megabits per second
MCM	Management, Control, and Maintenance
MDA	Ministries, Departments and Agencies
MYICT	Ministry of Youth and ICT
OLPC	One Laptop per Child
OPAC	Online Public Access Catalogue
PoP	Point of Presence
UR	University of Rwanda
Sida	Swedish International Development Cooperation Agency
SSO	Single Sign On

1. Introduction

This ICT Master Plan provides the guiding framework for implementation of ICT services and systems at UR. It incorporates:

i. The key projects to be implemented in order to achieve the aspirations of the UR ICT Policy. All these were discussed and agreed by the University of Rwanda (UR) stakeholders at the ICT Policy and Master Plan workshop;

ii. The planning implementation timelines;

iii. The budgetary costs that will also guide internal resource allocation as well as external fundraising; and

iv. Project management approaches.

Implementation must also be guided by the ICT Policy, which provides the policy boundaries and spells what needs to done and why; what is permissible; and what is not permissible. Other considerations that must be taken into account on an ongoing basis include:

i. Pre-requisites and co-requisites: What must be done first, or concurrently? The data communication infrastructure or a minimum component thereof, for example, must be implemented before Intranet services or information systems can be rolled out. There will also be interdependencies especially within the information systems that need data from each other. Time-tabling under Academic Management, for example, requires data on lecture rooms and laboratories, likely to be associated with physical assets under Finance Management, as well as data about academic staff that is drawn from Human Resource Management.

ii. Human resource: For each service or system to be implemented, there must be competent human resource to handle management, control, and maintenance. Users must also be trained as a concurrent requirement (just in time training approach). For clarity, this covers both the technical staff who handle operations (for example staff of the Finance Directory for the Finance Management Information System) as well as the ICT staff responsible for the engineering backend operations.

iii. Implementation Funding: The funding flow must be sufficient to enable the planned speed of implementation. UR will need to have a plan for mobilising funds internally, from government, from the local private sector, and from international development partners (multilateral and bilateral).

iv. Decision processes: The speed of decision making can have severe impact on implementation timelines if it is slow. This carries the additional risks of buying items at prices well above market value; and getting equipment that is no longer an industry standard. Both are the result of the rapid evolution of ICT.

v. Maintenance and Replacement Funding: Before any service or system is implemented, there should be steps taken to ensure that there are sufficient funds to support operations and maintenance, and later replacement. Funds for expansion should also be considered at the same time.

Achieving all the ICT Policy Objectives is a long term undertaking that will take 10 – 15 years and will need to be addressed using a phased approach. The preliminary costing[1] to achieve all policy objectives, excluding inter-campus connectivity (and international connectivity) for a university that has national coverage (See

Figure 1), is enclosed as an excel workbook giving basis and all other pertinent details (student and staff numbers). All these have been derived from data provided by UR. This workbook also provides for easy updating based on ongoing strategic decisions that will involve the closure of some campuses. This document covers the UR ICT Master Plan Phase 1 which has got the following key objectives that will also provide the platform for further development:

i. ***Consolidation of the data network infrastructure*** to ensure that:

   a. While campuses are in different geographical locations around the country, they can, through high bandwidth and low latency interconnectivity, intercommunicate so that from the perception of any user, they appear to be all in the same location (Phase should start at 1Gbps within the first two years, increasing to 2.5Gbps by the 5th year). *It should be noted that the costing here does not include the high bandwidth interconnection of the campuses using protected fibre links: UR management, working with RwEdNet, will need to negotiate with the government for free access to the national fibre infrastructure. This is necessary step if UR wants to remain competitive: other governments in the region have ensured that universities and research institutions can get access to intra-national fibre capacity either at no cost or at nominal cost[2].*

   b. Within each campus, there is a campus backbone with sufficient WiFi capacity to ensure fast and reliable anytime, anywhere access. A start will also be made on building LANs for selected areas where cabled access is critical. Campus backbones should be designed to start at a minimum bandwidth of 2.5Gbps that can be scaled over time up to 100Gbps;

   c. Network Operations inclusive of Help Desk and Disaster Recovery in consonance with the required service levels can be achieved through well-equipped and well-maintained data centres, along with network operations facilities. The historical structure where each campus had its own full-fledged data center will be rationalised, and decisions about centralisation and decentralisation of selected operations and support functions will be part of this implementation. *UR has already decided to set up its own Data Center at the College of Business and Economics, Gikondo campus. It is recommended that the Huye campus Data Center, which has been the main one, is set up as a Backup Data Center, and UR negotiates with government of use of the National Data Center as the Disaster Recovery Center.*

ii. ***Implementation of the core information systems*** – academic, finance, human resource, and library management – (preceded by harmonisation of policies and procedures across the different colleges, and streamlining to ensure efficiency) to create efficiency and cost-effectiveness in all management and administration activities of the universities. A key element of this is the Enterprise Resource Planning (ERP) system that was procured that requires a separate project around it to ensure that all gaps in implementation, as discussed

[1] The preliminary estimate is above USD 20million, but the data on which this is based needs to be further cross-checked by UR, and a decision especially taken on the approach for campus wide access to/ownership of computers.
[2] For example KENET, Kenya; TERNET, Tanzania; RENU, Uganda; ZAMREN, Zambia; and TERNET, South Africa.

within the UR ICT Policy, are addressed. To this will be added the other core information system – Library Management.

iii. ***Strengthening of the ICT Center*** to ensure that UR has in place a competent, sufficient, well-equipped, and well-motivated ICT Center staff to assure the availability of ICT services and systems within the agreed service levels is achieved. Building up this unit to the required level of competence will take longer than the first master plan, but the key foundations would have been established.

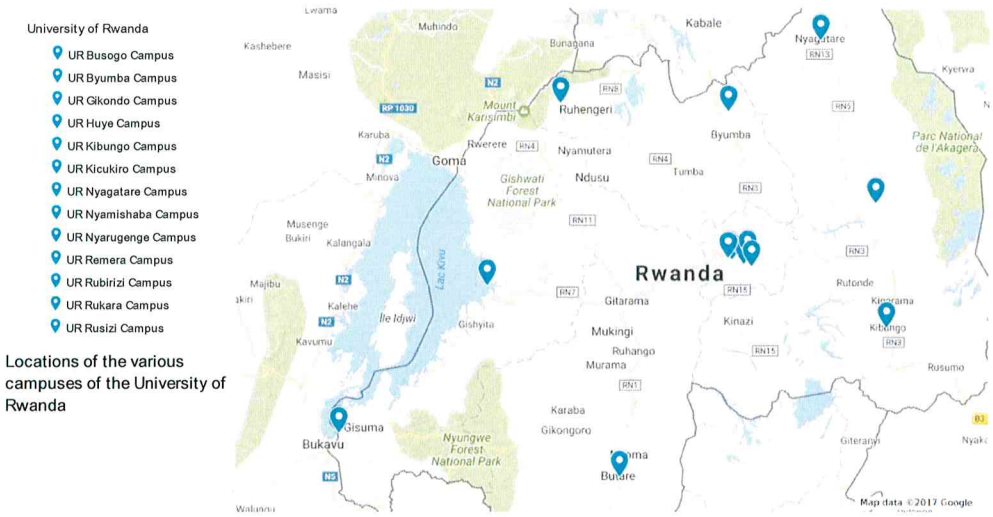
iv. ***Ensuring Sustainability*** by utilising approaches to the acquisition of ICT systems that not only ensure low costs of ownership but also create local capacity and potential for income generation. A start will be made on developing all university applications using open source tools with the long term objective of transitioning these from commercial to UR developed platforms during the second Master Plan. This will be complemented at the policy level by ensuring that:

   a. A technology fee is implemented to ensure that ICT services and systems can be sustained;

   b. Major capital acquisitions of ICT equipment are not carried out without assurance that there will be funds for maintenance and replacement of obsolete equipment.

v. ***Ensuring that all staff and students have the requisite skills for the full exploitation of ICT services and systems*** as demanded by their functions through continuing training intervention.

The achievement of these five objectives will lay the foundation for higher level objectives during Phase 2 that should be developed not less than two years before the end of Phase 1.



Locations of the various campuses of the University of Rwanda

Figure 1: Campuses of the University of Rwanda[3]

[3] This is available as an interactive map that will be provided separately.

2. Prioritised Projects and Project Management[4]

2.1. Priorities and Project Identification

The Stakeholders' workshop agreed on the projects in Table 1 that are listed according to the agreed priority. It should be noted that this is a starting point rather than a comprehensive listing of all the information systems that will be implemented over time. The Master Plan, like the Policy, should be continually reviewed to take into account the evolving environment, corporate priorities, and user-needs. It should be noted that the identified projects will be internally phased by the project teams depending on implementation capacity (human resource, funding) and pre-requisites.

Table 1: Prioritised Projects[5]

	Proposed Action/Service/System	Agreed Priority Rating	Remarks
1	Strengthening of the ICT Center (personnel, capacity, and equipment): Give chance to local human resources building their capacity.	1	Was (6) but UR agreed to have "Just in Time" training right from the start
2	Completing the campus data backbones	1	
3	Setting up the University Intranet	2	Was (7) but agreed that Data Center is a pre-requisite for Information Systems
4	Academic Records Management Information System	2	
5	Completing Local Area Networks in Buildings	3	
6	Improving campus WiFi coverage to cover all locations with sufficient user capacity	3	Was (8) but UR agreed that it should be concurrent with Campus Local Area Networks
7	Library Management Information System	4	
8	Finance Management Information System	5	
8	Human Resources Management Information System	5	
10	Development of ICT in Learning policy-Standalone	6	
11	Development of Research Policy	7	
12	Training End-Users	8	
13	Executive Management Information System	9	
14	Expansion of Computer Labs	10	

Following the phased approach and based on the prioritisation, and recognising the challenges of human resource (shortages in numbers and skills) as well as funding, only the projects that have a priority rating of 1 – 5 have been included in Phase 1 of the Master Plan. There is one exception to this that have been included in Phase 1: While End-User Training was given low priority, it has to be recognised that without a sufficiency of user skills, the heavy investment in ICT resources will not be optimally exploited

Phase 1 Projects will include:

[4] Parts of this will be generic as they apply to any environment, but the prioritisation and management approach are specific to UR stakeholders' decisions.

[5] Development of the E-learning Policy and the Research Policy, were recognised as priorities by the stakeholders' workshop. Action of this is outside the scope of the ICT Master Plan

i. Data Network Project: Ensuring that all the thirteen campuses have the required data backbones, building LANs, and WiFi coverage. Any building LAN implemented at any stage will also include the necessary desk top PCs;

ii. Network Operations Center (NOC) /Data Center Project: This project is implied under both the Data Network Project and the Intranet Project, but has been brought out explicitly because it is a major component. Improving and Expanding the NOC and Data Center, along with relocation, and setting up a Backup Data Center and a Disaster Recovery Center are all part of this Project;

iii. Strengthening the ICT Center (ICTC) Project: Strengthening ICTC in terms of having a sufficient range of expert personnel, requisite skills, and equipment/ facilities;

iv. Corporate Management Information Systems Project with five major sub-projects, each of which will be implemented by a different team but with a very high level of collaboration and coordination among the teams, especially noting that Academic, Finance, and Human Resource are part of the same ERP.

   a. Academic

   b. Finance

   c. Library

   d. Human Resource

   e. Executive Management

v. Setting up the University Intranet: Development of portal with linkages to all internal services and applications, including the university web pages, access to the Internet, application servers, and email services;

vi. End User Training Project.

The rest of the projects will be addressed in Phase 2, to be defined as part of Phase 1 implementation, and some of the elements which may overlap with some Phase 1 projects.

2.2. Key Project Elements in each Project

2.2.1. Data Network Project

This has got several elements as listed below:

i. A technical audit to confirm that the current network designs where they exist along with any associated routing is consistent with a well-engineered data communication network.

ii. Based on the audit, design and dimension modifications and/or additions to the campus backbone (including building LANs) that are consistent with sufficiency of capacity for projected needs and utilisation over the next 15 – 20 years, including active devices scaled for sufficiency over a 5-year minimum life-time. This would include phasing the implementation according to university priorities and resource envelope. It would also

involve deployment of sufficient public IP addresses to address the foreseeable needs at each location to eliminate the kind of recurring challenge that has been created by public IP address changes in the Library[6].

iii. Assess bandwidth requirements and agree strategies and a growth path for improved bandwidth, along with delivery of connectivity to the end-user that includes a scheme for owned laptops/tablets.

2.2.2. NOC /Data Centre Project

Establishment of the Network Operations Centre (NOC) and Data Centre requires an assessment of the switching requirements, data storage capacity and 24x7 availability requirements, as well as NOC requirements to provide all-inclusive services that include:

i. Network operations management;

ii. Systems' applications and databases;

iii. General data storage needs for UR and its units as well as students and staff;

iv. Intranet as well as Internet access;

v. Security of the network and the systems.

The current main NOC and Data Center are located at the Huye campus. Many of the other campuses also have their own historical data centers and NOCs. This creates a major challenge of additional costs due to duplication of equipment as well as operating costs. The first step is therefore for ICTC, with the approval of the ICT Steering committee, to take decisions on:

i. The location of the UR Data Center and the NOC;

ii. The location of the Back-Up and later the UR Disaster Recovery Center;

iii. The routing and/or switching facilities that will be required at each campus, dependent on campus size and the need for sub-centers for switching.

The NOC will require network and Data Centre monitoring and control stations, along with display screens that enable visual monitoring of the status of all links, switching centres.

2.2.3. Strengthening ICTC Project

The ICT Policy provides guidance on the core functions related to information resource management. The starting point is therefore assessment of the gaps in the range and skills of staff as well as facilities within the ICTC as a basis for interventions that will include:

i. A review of the organisational structure and terms of service;

ii. Recruitment to fill key gaps initially, and to gradually have a full staff complement by the end of 2021/22;

[6] This has created challenges access to online journals that utilises originating IP addresses for authentication: changes have caused repeated disruptions.

iii. Capacity building based on "just in time" approaches through exposure to best practices in the management, control, and maintenance of university ICT resources based on attachments and secondments, and longer duration training where justified. It should be noted that for the manager level staff in ICTC, this should include executive skills development.

iv. Provision of equipment and tools to enable their day to day work;

v. Provision of a working environment (furniture and facilities) compatible with the need to stay long hours on duty.

2.2.4. Corporate Management Information Systems Project

Implementation of information systems will be guided by policy, systems analysis and re-engineering, and requirements statements led by the technical people in each area (student records, human resource, finance, and library). It should be noted that effective systems re-engineering also leads to organisational changes, and that change management as detailed in the Change Management Policy within the ICT Policy will be a major element in implementing information systems. A key consideration in procurement will be the need to exchange information by operating from corporate databases that are able to exchange information at the back-end. The reality is that there is an ERP already in place, but this has to be revisited right from the first stages so that gaps are addressed and the current failure turned into success.

The implementation of Information Systems will follow the following three stages.

The first stage:

a) Creating awareness and getting involvement and ownership of functional staff and other stakeholders;

b) Systems analysis and business process redesign, including approval by university management of consequential policy and structural changes;

c) Functional specifications;

d) Decision on make, or use an open source solution, or buy (this will apply only to the Library Information System since a buy decision was made and an ERP procured for three of the core systems). It should be noted that funds will need to be set aside for the ERP: bespoke work to customise the system to redesigned processes will be needed;

   a. If Make, there will assignment of responsibility to an internal team that should nevertheless have clear contractual obligations. A contract in this context means that even an internal team must be subject to contractual requirements that include conforming to the functional requirements, deliverables, and timelines. It should be noted here that while an ERP system is in place, the policy decision is to start on the development of the major applications at UR so that the commercial system can be phased out during the second Phase of the Master Plan.

   b. If Buy, Request for Proposals; evaluation of bids; contract negotiations; and award of contract.

The major deliverables of this stage are: the final decision about the specific software package (internally developed or procured from outside); service levels, and contract terms.

The second stage:

a) Procurement of the hardware facilities;

b) Development OR procurement of application software and other resources; and

c) Implementation of the information system.

The main deliverables of this stage is an operational information system along with complete, documentation and trained personnel.

The third stage (transitioning):

a) Even after commissioning, major applications are prone to inconsistencies and glitches that need to be fully identified through live operations under full load. Business continuity demands may require that the associated risks be addressed by running both the old manual system and the computerised system in parallel for some time.

b) While every effort must be made to have data in electronic form before the electronic information systems are brought on line, it is a reality that data migration will take a considerable amount of time (and may run for several years) because of the resource demands it imposes. This means, for example, that a current final year student will go through their graduation based on the manual system while a new first year student will have all their data captured in electronic form and will be administered through the computerised system throughout their stay.

2.2.5. Intranet/ Internet and Automation Project

This project is focused on ensuring access to all services (according to access levels) by staff and students and will include

i. Access to the Intranet and the Internet;

ii. Automation: this ensures "Last inch" access, to ensure that each member of staff and each student has sufficient access to a computer to enable their day to day activities through the provision of dedicated computers, or shared computers in computer labs

iii. Email services

iv. Access to internal applications and resources (information systems and services that include library services, e-learning, etc.) along with the associated corporate databases

v. Access to applications (with identified priority software with a sufficient number of user licenses)

vi. Implementing a Single Sign On (SSO) to allow users to login to multiple systems with just one set of credentials: Once a user logs into the Intranet, they should be able to access any university ICT service or system to which they have access rights.

vii. Other services to be identified during the Policy and Master Plan exercise.

2.2.6. End User Training

The End-User Training Project Team will address the following core activities:

i. Carry out a comprehensive assessment of the training needs of students and staff in order to develop suitable curricula for addressing the needs of both general and specialised users;

ii. Identify and develop the capacity of a sufficient number of trainers from among the current university staff or senior students;

iii. Develop training content mainly based on an online self-led learning approaches, but with provision of initial direct training for those who lack basic computer skills (especially first year students and some of the continuing staff);

iv. Work with the Automation sub-project to ensure that all trainees will get sufficient access to computers through general computers;

v. Conduct training to achieve the policy objectives.

2.3. Project Management

Each of these projects, and each major sub-project, will be assigned to a Team that has the functional knowledge and technical capacity to plan and implement the project, including tactical and strategic changes in the implementation plan based on a sound framework for monitoring and evaluation. This will make six Project Teams. For avoidance of doubt, each team will be led by a person trained in the major functions of unit and is also empowered to take key administrative decisions: as an example, the Library Management Information System should be led by the University Librarian. Each team will be composed of individuals with expertise in the area (for example Finance and Accounting) as well as end-users.

Each Team shall be required to prepare for approval a detailed implementation plan and detailed budget, along with a clear identification of assumptions/ risks and how these will be dealt with.

This multiplicity of teams working towards a common end will call for close coordination at different levels:

i. UR ICT Steering Committee: It will be required that all Teams report to this Committee at a formal meeting once a month or, in the worst case, once every two months during the project phase.

ii. Consultation with the Architecture Working Group (when in place) for assurance that all plans conform to the agreed information architecture.

iii. Inter-Committee consultations as often as needed to ensure that pre-requisites and co-requisites are always in place in time for successful implementation.

The UR CIO will be the overall **Project Coordinator** for the implementation of the Master Plan.

3. Planning Timeline

Table 2 below gives the indicative planning time line. This timeline will need to be adjusted periodically based on a realistic internal assessment that takes into account:

i. The sufficiency and range of skills to carry out implementation, especially the applications development for the major information systems;

ii. Availability of funding, both for implementation as well as recurrent funding for sustainability;

iii. The speed with which decisions can be taken, especially relating to major changes as these will involve consultations with government.

It is assumed that for each project, the first six months will be used for project planning and design (includes both technical design and project planning as appropriate).

Table 2: ICT Implementation Master Plan Time Line

	Project	2017/18		2018/19 (Design and Planning)		2019/20		2020/21		2021/22 (Red Lines continue beyond the year)	
1	**Data Network**										
1.1	Campus backbones										
1.2	Inter-campus connectivity										
1.3	Wi-Fi										
1.4	Building LANS										
2	**NOC and Data Center**										
3	**Strengthening ICTC**										
3.1	Organisational Definition										
3.2	Recruitment/Capacity Building										
3.3	Equipment and Furniture										
4	**Corporate MIS**										
4.1	Library										
4.2	Academic										
4.3	Finance										
4.4	Human Resource										
5	**University Intranet**										
6	**End User Training**										

4. Planning Budget

Table 3 shows the Planning Budget for the Phase 1. The budget helps identify how much more UR should raise internally, or from government; or from other local and foreign development partners beyond the commitment by Sida to this phase of implementation. The background to the figures used here is provided in a separate workbook along with explanatory notes.

Table 3: UR Phase 1 Planning Budget (See workbook for details)

	Project	Amount (USD)	Remarks
1	Data Network	8,000,000	
2	NOC and Data Centre	2,000,000	Includes requirements for (5) – University Intranet
3	Strengthening ICTC	400,000	Includes training and equipment as well as the engagement of a project manager/mentor to support the university during the first 18 months of implementation.
4	Corporate MIS	800,000	
5	University Intranet		Incorporated in (2) – NOC and Data Center
6	End User Training	200,000	
7	Implementation costs	1,400,000	Includes a Project Manager and ICTC Team Mentor for 16 months, and staff costs at UR for 20 full time equivalents for 5 years
	Contingency sum (about 10%)	1,300,000	
	Total (rounded)	**14,000,000**	

Acknowledgements

The University of Rwanda would like to express sincere appreciation to the people of Sweden who, through the Swedish International Development Cooperation Agency, Sida, have funded the expert support for the development of the UR ICT Policy and ICT Master Plan. The support of the government of Rwanda and its agencies, through participation as well as financial support for the process is also acknowledged.

The enthusiastic support and participation of UR management, staff and students have been the source of all the decisions made to guide ICT the formulation of the ICT Policy and ICT Master Plan, and this will provide a strong foundation for ownership and success.

Finally, we would like to appreciate the support of our Swedish partners, BTH, in this initiative; and the consultants, Knowledge Consulting Ltd, for guiding the process.

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