

ANNEX I. Rwanda's ICT Capability Maturity Level Analysis

 Rwanda
 Korea

Category	Diagnosis Area	1	2	3	4	5
		Initial	Information/ Interaction	Transaction	Full-Integration	Transformation & Participation
Infra structure	Network	Backbone network is established for main national nodes, providing basis for information communication.	Main national network by sector (ex. Admin, Finance, Education, National Security, and Defense) is individually and physically established, and data is efficiently linked between main national networks resulting in efficient and effective national information communication.	National information network is established considering stability, usability, security and expendability; network is separated and individually operated internally divided as external/internal network, internet network and etc., considering characteristics of network and service.	National information network is closely established to be used based on purpose, region, and business user. It is established to be able to provide variety of information related services.	Network management solution is setup to control performance and elements of the network efficiently to enable future's integrated service environment (M-Gov., SMART Work, Mobile Office, Cloud Service, and etc.).
	Tele-communication	Telecommunication infra is established through mobile/telephone penetration; current network level is at 2-3G, and communication infra for transmitting and processing data is not sufficient.	Efficient task processing through lan/wireless broadband, high-speed internet and other means is possible for the sectors with main national network (ie. Admin, finance, education, national security & defense); and lan/wireless broadband expansion centered around regional hub.	Not just main national network but overall mobile, lan/wireless broadband penetration is above 50%, and communication, efficient information sharing and transmission is possible between key department and region, and between individuals.	Broadband and telephony service are distributed throughout the nation (over 80%); introduction and expansion of private line, digital data exchange (DDX), LTE service enable seamless transmission of voice, information, and data.	Nation is connected through 'Network Society', allowing information transmission and sharing, utilization and demand convergence (video conference, internet phone, etc.) along with communication environment that can be utilized by any devices.
	Cyber Security	Physical security for data, system, network, and application is established, responding cyber threats against administrative and industry.	Centered around key administrative sector, physical and logical cyber security is set up; and accident preparedness related to cyber security system is established by sharing information related to security accidents and responses.	Physical & logical security systems are established for key administrative and industrial institutions; all cyber security issues, DDoS and breaching of information are managed and responded, establishing nation cyber security center.	Cyber threat trends, weakness analysis are shared throughout the administrative, local, and key industrial institutions with information sharing system for cyber threats; national level cyber security center and respond team are organized and operated.	Responding to complicated & various cyber attack, preparedness system is equipped with cyber security analysis and control system, absolute defense system against state-of-the-art cyber threat system (cloud related hacking, DDoS) is established.
	Access Device	Wire/Wireless devices (Phone/Mobile) are distributed but it is limited to simple communication.	Devices (i.e. PC, laptop, smart mobile, telephone, fax, etc.) with access to the data network and services are distributed actively for the sectors with the main national network (ex. Admin, Finance, Education, National Security, and Defense); Through regional hub, PC and access devices are continue to be distributed. (expansion)	Not just limited to the main national network, mobile (beyond 3G), wire, & broadband penetration rate is over 50% throughout the nation; efficient communication and data sharing, transmission are possible between key institutions, locations, and individuals.	Penetration rate of PC, smartphone, tablet, and telephone is over 80% throughout the nation; data sharing, information sharing and seamless communication is possible between government, industry, and individuals.	Utilize sensors are chips that enables IoT (Internet of Things) to share and connect information through network for various different products not just limited to home appliances and electronics but to healthcare, remote inspection, smart home, smart car, and others. Also, "Any Time, Any Where" ubiquitous computer environment is set up through SIM (Subscriber Identity Module) & etc.
	Access Environment	Standards for security, authorization, connection methods are defined to connect and utilize wire/wireless communication services.	Connection (i.e. VPN), authorization (i.e. name verification, e-signature), and security system (encryption, PKI) has been developed to utilize services provided through main national network.	Not just limited to main national institutions and industries, but for any individuals, secure service connections are possible through fully established (100%) system of authentication, security and connection methods.	Utilization of all national information services and access through issuances of certificates to the individuals, and PKI (Public Key Infra.) system is applied through web/mobile services and being utilized.	Regardless of device and communication environment, security, connection, and authentication systems are fully established for internet connection; monitoring system is equipped for traffic checking, recording and managing.

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ICT Capability	ICT Ecosystem	Even though companies in private sector currently exist in order to develop / operate National ICT, their level is poor and support from other advanced country is needed.	Companies exist to develop / operate National ICT. Responsible departments and private sector companies individually meet off-line to independently develop/operate.	Efficient and transparent demand and supply management is enabled by e-procurement of different departments and private sectors.	Governments and ministries enforce systems to continuously support private sectors to gain profit. They also operate integrated/joint businesses with private sectors to develop the industry's ecosystem.	ICT services for national ICT development are being provided through private sector's voluntary participation and public sector's cooperation. Work efficiency is being promoted through cloud system.
	ICT Skill	There are insufficient IT skills to realize and execute national ICT. Also, current employments do not have any ties to the related license certifications.	IT skills necessary for national ICT are defined. Licenses and education programs exist. However, these licenses and programs fail to link with the employment. Also, private sectors and public sectors are not divided.	Skill sets, HR pool, license certifications, education programs necessary for national ICT are systematically being defined and operated at a national level. private sectors and public sectors are divided by role and responsibility but are not systemized.	Under IT skill sets necessary for national ICT, educations and employments are regularly held and conducted. Related skills/knowledge are managed by maintaining a database.	IT skill sets are managed through a certain knowledge system database. These knowledge/skill information connect to online educations and continuous employments. Also, employment opportunities will be provided to private sectors in which each department will secure its competence.
	ICT Affordability	National ICT experiences difficulty in autonomous financing and relies on foreign nations' aid or foreign companies' investment.	Financing is partially available by business fund system, tax, and etc.. Related information is managed manually without any system.	The national ICT business is being financed under the government management. Past financing performances are monitored through a system.	With the cooperation of private enterprises / companies, the government is preparing funds for the national ICT. Securing financial resources and monitoring performances are possible through a system.	Government is co-working with private enterprises to secure financial resources. The national ICT is being operated by fund system, tax, and government financing. Financing/information estimation/analysis/performance monitoring are available through a system.

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Governance	Control Tower	The necessity for a control tower(NCIO) to secure consistency and efficiency in promoting a national ICT business is being realized and functions to execute related tasks are being implemented. (Operated as a virtual organization)	A control tower(NCIO) is organized to efficiently develop national ICT business under a consistent standard. Each department's role and responsibility is clearly defined.	Operation process, laws & regulations, and collaboration build-up between each department's ICT team is arranged so that the control tower(NCIO) functions fully. National ICT businesses are being operated under NCIO's governance.	An ICT ecosystem is formed between the NCIO government organization and private sectors. Business selection and development process is managed transparently through e-procurement. After completion of developing a business, each information resource is sent to a cloud based national data center and managed systematically.	The control tower (NCIO) handles everything that relates to the national ICT business. Overall progress of the national ICT business (planning-budgeting-ordering-performing-evaluation) is monitored and managed.
	ICT Standards	The government is realizing the necessity to set up standards for national ICT skills, and is partially defining some standards for development & skill.	A standard for skill and an EA(Enterprise Architecture) structure is defined. (Security, Data, Work, Applied-skills, skill standards, etc.) Organizations and processes are established to maintain these standards and structures.	To apply the national ICT's standard into each business, a system(or portal) is prepared to share such standard basis information. A system is prepared so that the law/regulation is applied to the related institutions & departments.	National ICT businesses operates referring to standard ICT information. After completing development of a business, each business's development information is registered to standard ICT management system to ensure that system is updated continuously.	Not only does the national ICT standard review the business development stage, it reviews the redundancy & connectivity during the planning/budgeting phase. A systemized structure exists to monitor and inspect after completion of each business.
	ICT Shared Service	Considering future system link and co-utilization, the standardization of development framework and common functions for the national ICT business is defined. However, its definition is poorly applied or used.	When starting a national ICT business, the business uses the standard development framework and common functions. However, each department is separately operated or partially integrated to the national data center.	When starting a national ICT business, the business uses the standard development framework and common functions. Departments' system and information resources are integrated to a cloud-based national data center.	A cloud service (Public/private/hybrid) not only integrates information resources of administration branches but also core institutions (Bank, School, government offices, etc.) in order to minimize operation costs.	National information resources (such as administration, industry, private information) are efficiently operated by applying cloud computing, SMART Grid technologies. It manages each sector's information resource demand estimation, integrated procurement, shared service, utility to create an optimized environment for operation.
	Policy & Regulation	The government realizes the necessity of laws/regulations for national ICT businesses. Part of the law/regulation is being improved.	To create a smooth process for the national ICT business, new laws & regulations are being established or supplemented. (such as national ICT law, e-government law, information security law, etc.)	A detailed guideline of related laws / regulations are prepared for institutions and departments as a reference. A system (or portal) exists to easily share and use information.	Considering its connectivity, a law/regulation system that consists of not only National ICT business-related laws/regulations but also related to media& communication is prepared. System to interconnect and share information when law/regulation is amended at a on-going basis is established.	Inspection and monitoring is performed for each business under the national ICT rule/regulation. An article exists and is managed to give a penalty when a law/regulation is breached. Laws & regulations are updated considering the ICT market change and maturity level.

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Service: Individual	Social Security	Through Digital ID system, individual can receive basic social security services.	Systematic management of information related to Medicare, basic Social Security, government support and other basic government social security services utilizing Digital ID; and issuing documents and requests through a system that manages information related to basic living (home, employment, education, real estate, etc.) is possible.	All the information from social security, education, finance, healthcare, economic activities, etc. is collected and managed in the perspective of individual life cycle management; an individual can handle various welfare-related activities such as application, inquiry, report, etc. online.	By establishing an integrated social security management network, integrated national medical information system, and etc., overall work processes are digitalized and connected; various advanced social security services can be provided.	Information related to individual social security, education, finance, healthcare, economic activities are integrated and managed; customized social security services in accordance with individual preference can be provided.
	Health	A basis of ICT in healthcare is established e.g. digitalized medical data entry, medical history management, etc.	By digitalizing medical history, linking medical history with insurance information system, EDI, and other information can be shared by various medical institutions.	Telemedicine (diagnosis, reservation, etc.) service can be provided by online or mobile.	An individual can issue and inquire own medical history; by linking information with medical institutions on 'Any Where, Any Time' basis, remote diagnosis and treatment are available.	Individual medical history, health status, preferred food, and other information are managed on an integrated basis; customized services can be provided U-health, and self-check services through a wired/mobile devices.
	Education	A basis of ICT in education is established through digitalized information of students, teachers, schools, and etc.	Data from public/private educational institutions and government are integrated; data can be utilized for policy making, individual inquiry can be provided by centralized management.	Services like inquiry, application, etc. can be provided to individuals through an education portal.	In order to enhance quality of education, HR assessment and management are completed utilizing a data base. Also advanced education policy can be established reflecting current status and trend.	Through 'Smart School,' online digital education contents can be provided; opportunities for education in rural area are increased; interaction between students, teachers and schools are being improved as well.

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Business Industry	Agriculture	Agricultural information related to the technology, patent, licensing, tax, trend, harvest, and transaction are defined for digitalization.	Agricultural information in regard to technology, patent, licensing, tax, trend, harvest, and transaction are digitalized; basic data collection is being conducted allowing related personnel to access the information on a need basis.	Establish standardization of words. Agriculture related personnel can access the information related to quality, production, distribution, tax, price and pest control data real-time through an integration of scattered system to improve quality of the crops.	Collect various type of information related to agriculture through different channels; and provide transparent information and service through various analysis (Status, trend, etc.) by integrating scattered agriculture related systems.	Big data analytics is applied to agriculture policy making and individual farm operation; smart farming facilities and networks such as 'Smart Stable,' 'Smart Greenhouse,' and etc. are widely spreaded within the industry.
	Finance	Basic infrastructure for electronic financial transactions is established; PKI(Public Key Infrastructure) system and e-payment system are established	E-Commerce is revitalized throughout the whole country.	Basic B2C financial services(online e-banking, etc.) are available	Comprehensive B2C financial services(mobile e-banking, stock trading, insurance service, PB service, etc.) are established and available to the users.	Use of 'Smart Branch'(smart phone, tablet PC based mobile channel, ICT infrastructure such as video conference, etc.) to improve service quality and productivity.
	Service Ind.	Tasks that need to be digitalized are defined for service industry's efficiency and quality improvements (information collection, history of service usage, and etc.) that serves as a basis for ICT.	Data collection for main tasks and scattered information system is completed and for the quality improvement purposes, internal feedback process is executed.	Advanced system for improving service industry's efficiency and quality is established, and collaboration is possible as individual systems are exchanging data.	Integrate IT systems that are scattered throughout the individual systems to create integrated portal is set up and related integrated support center/control tower is also in place; and convergence to overcome separation of individual system area is also possible.	Paradigm transition is ongoing with new customized services development utilizing big data, and new market is being created with the collective intelligence through individual or group participation enabled by cloud technology.
	Manufacturing	Tasks that need to be digitalized for cost reduction purposes (tasks related to supply chain's efficiency and cost, tax, etc.) are defined by different phases providing basis for National ICT.	Scattered ICT for different phase of supply chain related information like key tasks & import/export, customs, and etc. are completed to enable data collection; and those information are utilized within the system and applied to manufacturing/production and delivery.	Data exchange and convergence is continuously attempted for the established systems for each supply chain phases, import/export, customs, and etc., through this, various cost reduction attempts like reducing bottle neck and optimizing cost and delivery are tried.	Scattered IT systems through different supply chain phases and import/export are integrated; Related process and systems are integrated into a control tower for management and forecast, providing supply chain's overall production, delivery, and related information's forecast.	E-Transformation that efficiently respond to changes in customer demand and diversification overlooking entire manufacturing value chain is progressing, and collaboration within company and business enables customized small-volume production and product innovation along with usage of e-Manufacturing.
	Transportation /Logistics	Basis for National ICT is set up by defining which areas to be digitalized within import/export, transportation costs, tax and other main tasks related to transportation / logistics infrastructure, method, and records.	Scattered ICT are carried out in the area of import/export, transportation cost, tax, and other main tasks related to transportation / logistics infra., and method enabling data collection of various different type of records and data.	Advanced system is set up for import/export, transportation cost, tax, and other main areas of transportation/logistics, allowing collaboration through data exchange between systems leading to establishment of efficient logistics planning and cost forecast.	Efficient management of overall transportation / logistics process through establishment of national logistics information center (integrating information of logistic means, infrastructure, import/export histories, tax) and single data center (integrating maritime logistics information).	Integrated logistics system based on RFID / USN provides intelligent and real-time monitoring and management of transportation/logistics processes; and accurate forecast and establishment of customized transportation / logistics system are possible through big data based on disclosed public information related to tax, transportation cost, price and etc.

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Business Industry	Social Infra.	Basis for National ICT is set up by defining which facility and tasks to be digitalized within city / traffic. (Rails, roads, etc.)	Individual ICT is established for defined main roads, traffic system, facility and etc.; collection of traffic related data enables user to obtain limited information.	Advanced operation management system is in place for city, traffic (rails, roads, etc.) and data exchange & convergence between individual system is carried out allowing traffic forecast and control.	Integrate individual traffic systems through integrated traffic information system and integrate traffic related facilities by city through integration to enable integrated demand forecast and management related to traffic and city facility usage is possible.	U-city service with real-time information communication for residents is provided and intelligent traffic system is established utilizing real-time traffic information to create optimal traffic environment.
	Energy	Electricity / energy fee is paid through management of electricity / energy usage.	Integrated management of information related to electricity/energy usage - enabling usage forecast, management, control, and other tasks; and continue to expand digital payment / claim functionality.	Forecast for electricity / energy demand & usage by region. Forecasting region with excessive usage and possible shortage can be identified and utilized. Individual digital fee claim / payment for electricity / energy usage is possible.	Integrated system to efficiently manage various energy sources at a country level is established along with the integrated life cycle management system with phase by phase resource cycle information for waste resources.	Energy infrastructure for environment is established through smart grid, integrated energy management, and demand forecast; along with resource blueprint deriving information by utilizing big data to analyze related information and forecast, and sharing new alternative energy information for solar, wind, and water energy.

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Government	Admin. Average	Basis for computerization is set up through defining administration related tasks with digitalized standards.	Main tasks are categorized into digitalized documents and responsibilities, and easy-to-use & convenient data center is established through rural areas diminishing information gap for regional disparities through providing limited but efficient and transparent data/information.	Main business systems (e-tax, e-custom, e-procurement, etc.) are connected and lined, and some portion of the tasks are standardized; and citizens can access the government information / data services leading to improvement in related services.	All the tasks related to procedures are standardized within department, and individual information systems are integrated / consolidated into national portal for processing / recording / management leading to integrated management for sharing and opening of public data & information through integrated information center.	Participation channel for citizens and collective intelligence facilitate collaborative environment by utilizing sectorial cloud; Provide customer-oriented government services by utilizing Big Data of disclosed public information, at the same time facilitate the promotion of industrial development and enhance technology-based national administration tasks through establishment of national future strategy center (Based on data analysis)
	19 ministry	Basis for computerization is set up through defining administration related tasks with digitalized standards.	Main tasks are categorized into digitalized documents and responsibilities, and easy-to-use & convenient data center is established through rural areas diminishing information gap for regional disparities through providing limited but efficient and transparent data/information.	Main business systems (e-tax, e-custom, e-procurement, etc.) are connected and lined, and some portion of the tasks are standardized; and citizens can access the government information / data services leading to improvement in related services.	All the tasks related to procedures are standardized within department, and individual information systems are integrated / consolidated into national portal for processing / recording / management leading to integrated management for sharing and opening of public data & information through integrated information center.	Participation channel for citizens and collective intelligence facilitate collaborative environment by utilizing sectorial cloud; Provide customer-oriented government services by utilizing Big Data of disclosed public information, at the same time facilitate the promotion of industrial development and enhance technology-based national administration tasks through establishment of national future strategy center (Based on data analysis)
	30 Local Gov.	Basis for computerization is set up through defining administration related tasks with digitalized standards.	Main tasks are categorized into digitalized documents and responsibilities, and easy-to-use & convenient data center is established through rural areas diminishing information gap for regional disparities through providing limited but efficient and transparent data/information.	Main business systems (e-tax, e-custom, e-procurement, etc.) are connected and lined, and some portion of the tasks are standardized; and citizens can access the government information / data services leading to improvement in related services.	All the tasks related to procedures are standardized within department, and individual information systems are integrated / consolidated into national portal for processing / recording / management leading to integrated management for sharing and opening of public data & information through integrated information center.	Participation channel for citizens and collective intelligence facilitate collaborative environment by utilizing sectorial cloud; Provide customer-oriented government services by utilizing Big Data of disclosed public information, at the same time facilitate the promotion of industrial development and enhance technology-based national administration tasks through establishment of national future strategy center (Based on data analysis)