Framework
for an
International Master of Science Programme
in
Information and Communication Technology
for
Development

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This document describes a proposed framework for an International M.Sc. education in the area of ICT for development, with specific emphasis on the developing regions.

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Introduction

The proposed framework is intended to collect together Swedish universities interested in an education programme focused on issues important for development cooperation. The framework should provide a common understanding of the issues involved and facilitate instantiations in the form of programmes formed by clusters of universities. Rather than having one programme per university, the idea is for several universities to supply courses which they are especially suited for and interested in. Each contributing university is called a *Programme Partner*. For each programme instance of the framework, i.e. for each cluster of Partner universities, there should be one administrating university, responsible for, among other things, the distance education platform, quality assurance, and the formal issuing of degrees. This partner is called the *Programme Coordinator*.

The programme is intended to be a joint effort between several universities inside (and possibly outside of) Sweden. A student is expected to take some courses in Sweden, some courses may be taken at a home university, and some courses are distance courses, possible to take anywhere in the world. The execution of a programme is initially financed by the usual Swedish university accounting system ("HÅS/HÅP") under given quotas. While Spider will assist in the development and continued refinement of the programme framework, its instantiations are ordinary university programmes. Specifics and details regarding course execution and planning will be worked out on two levels. Firstly in the general framework document finalized after the completion of the consideration round. Secondly in each instantiation of the framework where Partners participating in the cluster instance share a planning process for that programme.

The framework is modularized in order to facilitate the participation of many universities, in Sweden (and other countries), by supplying one or more courses. All participating universities should share access to a distance learning system, which should also be accessible from all students' home universities. This system will be used for course administration as well as for course communication between teachers and students, and also between the students. Some examination may also be conducted via the distance learning system. It will be a web-based system. Thus, Internet access is the only technology prerequisite for a university to send students to the programme.

The document is intended as a basis for discussion among universities interested in a national M.Sc. programme for ICT4D. Implications of the Bologna process must also be taken into consideration. The framework is not finalized. Rather, the suggestions below are to be seen as a starting point for the round of discussions scheduled for February 2005.

Background

While the technology itself contains many challenges, more far-reaching ones (from a development perspective) come from the way we could (and should) use ICT to improve, inter alia, education, health, industry, business, law, and also to extend the tools for democratic decision making.

This framework for an international M.Sc. programme in ICT4D is initiated by the Swedish Programme for ICT in Developing Regions (SPIDER), which is an initiative in Sweden to reduce poverty by promoting the use and the diffusion of ICT in developing countries.

The framework reflects views expressed in the Millennium Development Goals, defined during the United Nations Millennium Summit, that combating poverty, hunger, disease, illiteracy, environmental degradation, and gender equality should be one of the principal objectives of mankind along with upholding human rights, and promoting good governance and democracy. In this, ICT has proven to be one of the key technologies in combination with education in improving the Human Development Index. The Spider initiative is one of the ways for the Swedish academic community to contribute towards the millennium goals.

There is a growing demand for individuals skilled in the technology and deployment of net-centric systems, the management of information on hardware and software levels, open source software, figuring out when and how e-Democracy works, policies to decrease the gender inequality in accessing the Internet, or strategies to establish a certification authorities for the growth of the e-business environment.

A number of high profile meetings such as United Nations Millennium Summit and 8G gatherings in 2000, initiatives like the InfoDev programme by the World Bank, Dot Force, UN TF on ICT, the Soros Foundation, have identified the need for the introduction of ICT higher education programmes in a developing context within many academic communities.

The proliferation of university programmes that deal with ICT and its implications with respect to development, growth, economic and social sustainability and equity along the North and South metaphor, in general, has followed two familiar patterns. Namely, one of those patterns is to widen the regular curriculum of the MSc programmes in ICT, management, business administration, even social sciences and communities with one to two courses, in most of the cases, electives that specifically deal with ICT and its implications in innovative and creative thinking, the development of SMEs, improving public administration and its transparency and thus decreasing corruption, extending the reach of the educational and health systems via e-services, and f recognizing the cumulative effect that creates environment for sustainability and democracy. The other venue, which is much less travelled one, is to go all the way by developing complete graduate programmes, both on a master and

doctoral levels, and based on a wide range courses, from building a low cost ICT infrastructure to designing e-procurement and e-taxation national systems.

International Outlook

There are a number of initiatives and efforts from different parts of the world in this field. This short survey indicates that most of the partial or full-fledge graduate programmes have many similarities that are reflected in both the courses and the topics they cover. Moreover, the mentioned universities and their MSc programmes provide a basis for possible co-operation within the international character of the Spider's MSc Programme. Finally, it demonstrates that the ideas and concepts behind the proposed Spider's graduate framework is reasonable with respect to being attractive to students from different backgrounds.

The LINK Centre (participating in NetTel@Africa) is located at the University of Witwatersrand in Johannesburg, South Africa, offers an International MSc Programme for Development. The profile that is currently part of the university curriculum is Master of Management in ICT Policy and Regulation. Within the graduate programme there are four elective modules: Globalization and the Information Society, Information and Communication Technology Management in the Public Sector, Information and Communication Technologies and Development, and E-governance. The prerequisites for admission are usual – BSc degree, three years of work experience, and general entrance examination. There are two fundamental courses, seven core ones, and ten course-work modules. Some of the core courses are Universality and QoS Regulation, ICT Resources and Control Allocation, Market Structures of Telecommunication industry, while the set of electives includes Globalisation and Information Society, ICT Applications, Convergence and New Media in Information Society and so on.

The Agricultural University of Norway (which is responsible designing and operating the programme), the Institute of Development Studies at the University of Helsinki, and Centre for Development and Environment at the University of Oslo, have come up with a programme termed as "An ICT based graduate study programme in development cooperation for the early twenty first century". The language of instruction (which is Internet based) is English. Target groups are people from institutions of higher learning, donor agencies, and NGOs in the North and South. There are five thematic modules such as (1) Development theory and policy history from colonisation to globalisation, (2) Development approaches, methods, communication, participation, equity and cultural issues, (3) Development cooperation and rural, purposive change process, (4) Management of natural resources and the environment, and (5) Human resource development, including education, training, and health. The MSc programme ends with research on regional prospective and development, and a project for MSc thesis.

University of California at Berkeley, along with CMU and University of Washington offers a very comprehensive course under the title "An Information and Communication Technology (ICT) Framework for Developing Regions". It uses the

Internet as the main instrument for instruction. The course, which comprises of several courses in a normal academic setting, tries to address three principal questions with respect to

- Context – what are the major economic and social challenges faced by the developing countries,
- Application – what role could an effective ICT infrastructure play in solving these challenges, and
- Technologies – what are the technologies, architectures, basic services, and associated research to make such an ICT infrastructure affordable, useful and economically viable.

The Context deals also with the deployment of the legal/policy regulatory framework, infrastructure, private sector, and human resources. The Application looks at the ICT for economic growth, productivity, job creation, commerce and innovative outlooks. The Technology discusses the nature of networking (permanent vs. temporary), fault-tolerant and robust infrastructure in a limited knowledge environment, and interaction of technology with business models.

Another course is offered by the Richard Stockton liberal arts college in New Jersey, in the Computer Science and Information Systems department. The course is called "Information Technology in the Developing World". The following topics are examined rather thoroughly: ICT for development, who is the main players in developing efforts, the relation between the technology and sustainable human development, the Digital Divide, and other related technologies.

The Centre for Internet Studies at the University of Washington provides a pool of graduate courses that can actually, if selected by a student, lead towards MSc degree. These courses, inter alia, include Information Technology and International Development, Introduction to Global Internet Political Economy, IT Literacy for Low-Resource Environments, and Technology Planning in Low-Resource Environments.

The same is true for University of Sussex, which under the umbrella of Science and Technology Policy and Management, offers four different MSc programmes such as Science and Technology Policy, Industry and Innovation Analysis, Technology and Innovation Management, and Science and Technology for Sustainability. Some of the courses, that cross-cut into all four profiles, and which may be in the realm of Spider's interest, are Economic Perspectives of Innovation, Organisation of Innovation, Information and Communication Policy and Strategy, and Competing in Global Economy.

Delft University of Technology has a variety of programmes related to ICT, starting from classical Computer Science, to Telecommunications and e-Technology. Within the graduate programmes, in addition to the technical subjects, a wide range of "non-technical" courses are at the disposal of students (Customer Centric Service Architecture, Service Oriented Business Integration, and Responsive Regulation for Mobile Telecommunications). These courses lead mainly towards doctoral level

research, and there are a number of students from the developing countries who have produced dissertations in the area of ICT4D.

Spider's Initiative

Spider's initiative aims at providing a framework for Swedish programmes of the same kind as above. The framework is intended for students and professionals who would like to broaden and deepen their knowledge of ICT, its management, applications, and ramifications to the society as whole.

The framework is designed towards a number of student categories. These include, but are not limited to, EU nationals who desire to work with state of the art applications pushing the frontiers of current technology (which requires a solid knowledge of the limitations and how to overcome them), EU nationals with an inclination to work in developing countries, and most of all for the people from developing countries, who would like to lead their respective homelands through ICT on the path of stability and progress.

The programme lasts for two years, and is comprised of 16 course units of 5 weeks study each, where every unit yields a five point credit (or 7.5 ECTS). The initial module of the MSc prepares the students for a general awareness and expertise in ICT and management. The follow-up modules proceed with specific studies and research focused on the selected profile, where the students are expected to extend the depth and the mastery of knowledge relevant to the particular profile.

Common Platform

All students should have access to a common web-based distance learning platform that should be used for communication between students and between students and teachers. Course assignments could be distributed and collected on the platform. Having divided the students into smaller groups, there should be much interaction and even self-examination for some assignments. The progress of groups and classes as a whole can be monitored from a distance. There could also be fruitful interaction between students participating in different instances of the framework if care is taken to synchronize course parts. There are several learning platforms on the market, and no particular one is preferred at this stage. There is a tentative list of desiderata for a common platform:

- Course administration
- Discussion groups
- Support for course material:
    - web pages,
    - audio,
    - video,
    - annotated slide shows

- Chats
- Message boards
- Shared spaces for group collaboration
- File backup facilities
- Possibly blackboard application

If some of the above are too bandwidth hungry, there must be a low-bandwidth equivalent available as well. There are several candidates for a platform which have been proven effective in real settings. They range from more standard systems like WebCT or First Class (used by some of the Spider Partners) to specialized e-learning platforms such as the Sida sponsored platform in use today in Sri Lanka for teaching some 5,000 students mathematics.

Quality Assurance

The programme has mechanisms for quality assurance. The first mechanism is the common web-based communication platform, in which all teachers and others involved in the programme can communicate with each other and with all students. Through this platform, the development and progress of the courses can be monitored. All assignments and examination tasks will be available in computer readable form. The other mechanism is teachers' meetings, in which teachers involved in a particular track, stage, or block of courses can meet, either in person or via the platform, to exchange views and align requirements and teaching methods as required. There is even a possibility for teacher training if this is deemed necessary by the group responsible for the programme instance. (Such a group should of course include all Partners, not only the Coordinator). One candidate for teacher's training is skills in developing distance material, which is a bit different from ordinary course material.

Courses given by other Partners are included in the degree awarded by the Coordinator by the same mechanism that today allows students to exchange one or more semesters for studies abroad. Initially, the degree awarded will be a Swedish M.Sc. degree. Under the Bologna system, it is expected to be possible to issue International Master's degrees, but this is subject to information not yet available.

Entry Requirements

The main prerequisite for enrolling into the Master of Science programme is a completed B.Sc. degree in one of the three categories considered for the programme:

- Computer science / Computer engineering
- Natural sciences, mathematics or other engineering disciplines
- Business administration or economics

A principal idea with the framework is to raise the general awareness and knowledge of ICT4D in students who come from different education profiles and backgrounds. Therefore, the programme has three entry points, which are

- **ICT –** for students with a major in computer science, computer engineering, telecommunications, or information systems. Basic skills in computer related subjects are pre-supposed. The students will follow the ICT specific track for one semester. The initial courses will bring the students up-to-date in areas such as business administration and management.

- **Natural Sciences and Engineering –** intended for students with a major in natural sciences, mathematics and other engineering disciplines (with the exception of those ICT based). These students, due to the nature of their background, are supposed to be more amenable to a faster pace in the ICT courses. They will also take some overview courses in business administration and management. The students will follow the Technology specific track for one semester.

- **Business and Economics:** This is for students with a major in business administration, economics, or possibly management. They will initially take a number of courses on ICT including both intermediate and advanced topics. The students will follow the Business specific track for one semester.

The entry points have differing entry requirements, thereby admitting students with differing backgrounds into the programme. After the first (track specific) module, the students are supposed to share a basic understanding of the subjects involved in the programme. During the following modules, they will gain deeper knowledge, especially on facts and areas of particular interest to the developing world. The students will also be able to learn from each other in assignments and project work during the programme.

The actual programme instantiation depends on the selection of the courses and consequently the universities that offer them. While it is flexible and suited to the individual interests of the student, the following three groups are suggestions for programme logistics.

As a suggestion, out of the 80 credit points, a student from

A. a developing country should take

- 30-40 p in Sweden
- 20-30 p in home country
- 20 p thesis where appropriate

B. EU is expected to take

- 30-40 p in Sweden
- 10-20 p in home country
- 10 p in a developing country (*)

- 20 p thesis where appropriate

C. Sweden should take

- 40-50 p in Sweden
- 10-20 p in a developing country
- 20 p thesis where appropriate

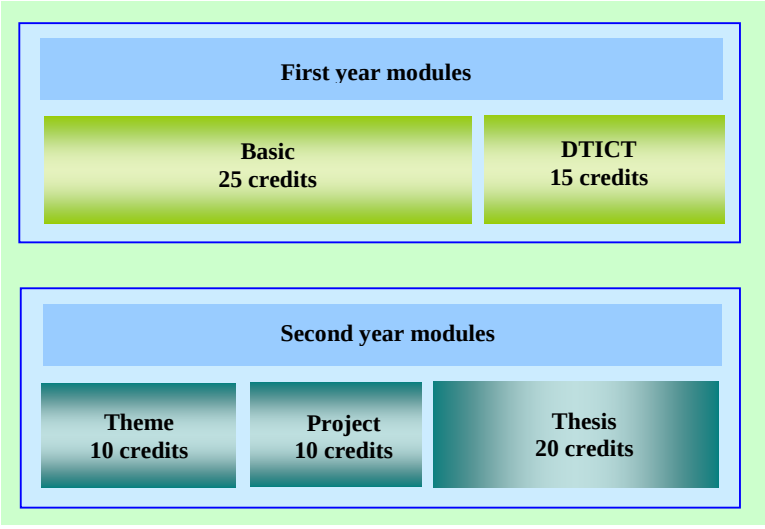
(*) SPIDER is not expected to undertake any financial commitment

Structure and Organization of the Curriculum

This is both a course and thesis based Master Degree programme. The duration of the Programme is 24 months and it is comprised of four full-time semesters or eight periods. The execution of the programme is subject to the legislation and quality assessment as prescribed by the Swedish Council of Higher Education.

The two first semesters can be taken at any of the participating universities. The third semester is given at a few universities, integrating the knowledge obtained. The final semester, which relates to the thesis work can be anywhere, however the submission is done at the Programme host university.

One or more participating universities may offer a part or parts of a particular course. In case of the later, the students taking the course are supported by the distance learning system. Therefore, it is very likely that there will be students participating in a course from his/her home country.



The general structure of the Programme, which consists of five different modules, termed as Basic, DTICT, Theme, Project, and Thesis, is shown in the figure above.

Module Overview

The programme is divided into *five* modules:

Basic module: This module tries to level the students with respect to basic background knowledge in several areas important to ICT4D. Areas include computer science, computer communications, information systems, business administration and management. There is also a regional course**.** Students from developed countries take a course in general developing world knowledge. Students from the developing world take a course in administration and management.

DCICT module: Reaching this module, the students are more equal in terms of general background knowledge. In the module, issues specific to developing countries are discussed. These include low bandwidth communication, open source software, and computer mediated services.

Theme module: After the DCICT module, the students have general knowledge and a set of tools for analyzing and understanding development issues in ICT. In the theme module, the students are allowed to specialize in some areas of particular interest to them. The theme module courses are packaged in recommended profiles, but individual study plans could be accepted.

Project module: In reaching this module, students have a general background and many special skills and knowledge. Students from differing backgrounds will participate in projects together. This will bring an interdisciplinary strength to the projects. Projects can be carried out in Sweden or in the home countries of students from other parts of the world.

Thesis module: The programme ends with a master's thesis, written either alone or in groups of two. The subject chosen should reflect knowledge gained during the programme and be of relevance to the developing world.

The programme and the exams are subject to the same legislation, conditions, and quality requirements as an all-Swedish programme.

Contents of the Modules

The schedule of the M.Sc. programme concerning the allocation and the order of the courses through periods is given below.

	Entry Points		
Period	**ICT**	**NatSci and Engineering**	**Business**
1	Course B1, 5 credits	Course B5, 5 credits	Course B8, 5 credits
	Course B2, 5 credits	Course B6, 5 credits	Course B5, 5 credits
2	Course B3, 5 credits	Course B7, 5 credits	Course B6, 5 credits
	Course B4, 5 credits	Course B4, 5 credits	Course B9, 5 credits
3	Background Levelling Course E1 or E2, 5 credits		
	DTICT Telesystems and Services, 5 credits		
4	DTICT Software Engineering, 5 credits		
	DTICT Policy, Laws and Regulative for ICT, 5 credits		
	Profiles		
5	**Net-centric Systems** Theme T1, 5 credits Theme T2, 5 credits	**Architecture of e-Society** Theme T3, 5 credits Theme T4, 5 credits	
6	Project, 10 credits		
7	Thesis, 20 credits		
8			

First Year

The first year consists of the **Basic** module and the **DTICT** module, the first worth 25 credits and the second one 15 credits, which amounts to eight courses. The courses could be taken at several of the participating universities, as long as they fit in the overall study plan of the student.

Basic Module

The Basic module is made up of four courses that reflect the background necessary for both profiles. The intent of this module is to provide solid foundations concerning the two major aspects of ICT: the technology and the ramifications of its implementation.

Depending on the entry point of a student, the set of courses for the three categories are the following:

ICT

B1: Accounting and finance
B2: Management and marketing
B3: Information society theories
B4: Risk and decision analysis

Natural Sciences and Engineering

B5: Computer networks and Internet technology
B6: Web architecture and tools
B7: Finance and management
B4: Risk and decision analysis

Business Administration

B8: Computer hardware and software
B5: Computer networks and Internet technology
B6: Web architecture and tools
B9: Information systems

After the Basic module, each student should meet the fundamental knowledge criteria in the following areas:

- Information technology
- Computer networks and the Internet
- Project management
- Product marketing
- Policies for development
- Viable Business Models
- E-society models and theories
- Risk and Decision Analysis

An extension of the Basic module is done through two five point courses. A student is required to take only one. It is expected that EU entrants would take 5 p in issues relative to the developing world, while students from the developing world would take 5 p in the human infrastructure, the relations, and both administrative and management issues that are main constituents of a contemporary civil society.

Developing/Developed Extension

E1: Developing world issues
E2: Administration of civil society

ICT4D Module

The next three courses are part of the ICT4D module and are mandatory for all students, independent of their entry point or profile of specialization. This is done in order to preserve the multi-disciplined nature of the Programme and to induce the possibility of joint research work, in which different aspects of the same problem may be addressed.

They discuss ICT issues common to developing regions all over the world through topics such as, inter alia, inadequate communication infrastructure (with low bandwidth and reliability), open source software, free electronic publishing, knowledge dissemination and communities, universal accesses and service, telemedicine, interfaces for decoupling usage from education, market liberalization, inducing competitiveness, promoting ICT entrepreneurship, ICT policies and policies for ICT, and laws and regulations for ICT.

I1: Telesystems and services
I2: Software engineering
I3: Policy, laws and regulative for ICT

Second Year

The ambition of the three modules in the second year, viz. **Theme**, **Project**, and **Thesis**, is to combine the individual interests of the student with the specific needs of his or her background (being that a developing country or developed one, an organization or an institution). Simply, the topic entertained during second year should mirror the reality of the problem being defined and solved. The inherent co-operative nature of ICT, enriched with possible filed studies, should be strongly encouraged.

Theme Module

There are two fundamentals themes in the MSc programme, Networks and Internetworking ("Net-centric Systems") and Services ("Architecture of e-Society"), both put in the context of developing country issues and concerns.

The profile in ***Net-centric Systems*** is about the nature of information and information processes, their interaction and distribution via networks and media, especially in the form of services. It builds on the confluence of communication and computing paradigms and the universality of Internet protocols. The study of databases, large multi-language data warehouses and their efficient storage and mining, the design of networks that offer a spectrum of possibilities based on a transparent infrastructure and seamless access, the intelligence in systems in order to recognize the multi-culture impact on the information are examples of possible topics. Reliability, scalability, security, and privacy of these systems are necessary conditions for their wider acceptance both by the public and the private sectors.

In the second profile, ***e-Society Architecture***, the key idea is to model the dynamics and the complexity of social systems by representing them as information systems based on a network of collaborative agents. The ontology of the information systems, the organization of business and governmental activities, the interactions of the citizens in the society based on information, the development of anthropomorphic Web interfaces, and the degree of their usability are among the concepts that are going to be studied. How to produce a national system for e-Learning, or to define a sound

ICT security policy for the public sector in a country with very limited human and financial resources, are viable questions that could be investigated in this profile. Some other topics include the effect of the Digital Divide with respect to age, education, and economic potential, or the technology of e-learning.

An intensive collaboration between the two profiles is expected and supported. Firstly, by the core modules, which are composed from courses that should level the different background knowledge, secondly by the requirement that both profiles take three mandatory courses about ICT4D, and thirdly by joint research projects and thesis work.

The Theme module is given at selected universities, integrating the knowledge obtained and bringing together the students of the programme, exploring the task of working together with people from different backgrounds. The exact number of topics depends on the interests of the students and the possibilities of the participating universities. Examples of topics for the two respective profiles, Net-centric systems and the Architecture of E-society, include

- e-Learning and education
- e-Government
- e-Health
- e-Science and research
- Convergence of teleservices
- Legislation in networked society
- Security Policies and Strategies
- Network Technology and Design
- ICT Business Models for SMEs
- Digital Divide
- e-society models and theories
- Open source development

Project Module

The **Project** module, which is made up of a ten point course, is supposed to teach the student about the essentials of research methodology, the problems, and the characteristics that define the area of his or her specialty as a proper discourse for the Master Thesis work. The project module also includes lectures on paper writing and research methodology in order to prepare for the project report and for writing the thesis in the next module.

Due to the participation of students from different backgrounds, the course serves as a knowledge and experience integrator. The course will require co-operation between several students in each project, thus providing cross-fertilization and understanding of various views on the issues related to development. The duration of the project is ten weeks.

Thesis Module

The Master Degree is completed with a thesis, which may be written either individually or in groups of two. The work should indicate the ability of the student(s) to identify, define and solve a problem pertinent to ICT4D. This work, as well as the opposition is part of the **Thesis** module.

The actual studies and research relevant to the thesis may be done in any country. The supervision of the student(s) can be in person, at a distance, or a combination thereof.

Upon the submission of the thesis, the student(s) makes an oral presentation of his, her or their work. The presentation is part of a seminar, where the student(s) also comments and evaluates the work of his peers. The final grade is based on the results from the written thesis, the oral presentation, and the peer review.