Building ICT Facilities for Education in a Developing Country. Analysis of an ICT Project at Tumaini University/Iringa University College 2000-2004.

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University of Joensuu
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Master's Thesis

Abstract

In this research it is analyzed, how an ICT project implemented in a higher educational institution of a developing country succeeded, and what was learned during the design and implementation processes. The perspective is a western expatriate's and an ICT professional's, who had a key role in the project.

The project was realized as planned both in terms of timetable and finance in spite of some minor exceptions. The most obvious weakness of the project was that the needs of the administration of the college were not paid attention to at all. This weakness accumulated to all activities implemented during the project.

How successful a development project turns out to be depends on three major contextual factors: available resources, climate and environment, and people and culture. A western ICT professional should analyze them carefully when implementing an ICT project in a developing country. Also the phases of cultural adaptation have to be known and their impact on the project has to be anticipated already when plans are being made.

ACM Classes (1998 version): K.3.0, K.3.2, K.4.0, K.8.3.
Keywords: Development project, ICT, ICT education in developing countries.

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Viite pro gradu -tutkielman tarkastaminen

Asia **Jyri Kemppaisen laatiman tietojenkäsittelyn alan pro gradu -tutkielman arvosteleminen**

FT Jarkko Suhonen ja professori Seugnet Blignaut ovat tietojenkäsittelytieteen ja tilastotieteen laitoksen määräämінä tarkastajina tarkastaneet Jyri Kemppaisen filosofian maisterin tutkintoa varten laatiman pro gradu -tutkielman (15 ov) "Building ICT Facilities for Education in a Developing Country. Analysis of an ICT Project at Tumaini University/Iringa University College 2000-2004" ja ehdottaneet arvosanaksi eximia cum laude approbatur.

Joensuun yliopiston hallintojohtosäännön mukaan tiedekuntaneuvoston tehtävänä on tarkastajien lausuntojen perusteella arvostella tutkielma sekä antaa päätös tutkielmaa koskevaan oikaisupyyntöön (§ 9).

Matemaattis-luonnontieteellisen tiedekunnan tiedekuntaneuvosto on kokouksessaan 16.8.2006 päättänyt valtuuttaa tutkielman tekijän suostumuksella tiedekunnan dekaanin arvostelemaan pro gradu -tutkielmat tarkastajien lausuntojen perusteella, mikäli tarkastajat päätyvät yhdenmukaiseen arvosanaehdotukseen.

Päätös Jyri Kemppaisen laatima tietojenkäsittelyn alan pro gradu -tutkielma arvostellaan arvosanalla eximia cum laude approbatur.

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UNIVERSITY OF JOENSUU
Department of Computer Science and Statistics January 4, 2007

Review of Master's thesis

As reviewers appointed by the Faculty of Science we have studied the Master's Thesis in Computer Science (173315, 15 cu) *Building ICT Facilities for Education in a Developing Country. Analysis of an ICT project at Tumaini University/Iringa University Collage 2000-2004"* by *Jyri Kemppainen (157391)*, supervised by PhD Jarkko Suhonen.

Numerical review

	1	2	3	4	5	6	7
problem specification		X					
knowledge of literature		X					
organization of thesis	X						
independecy and originality	X						
presentation of results		X					
clarity of expression			X				
merit of technical presentation		X					

(1 = laudatur, 2 = eximia cum laude approbatur, 3 = magna cum laude approbatur, 4 = cum laude approbatur, 5 = non sine laude approbatur, 6 = lubenter approbatur, 7 = approbatur)

Verbal review of Seugnet Blignaut

1. Problem specification
The setting of the problem is clear and concise. However, the setting of the problem does not warn the reader of the intensity of the problems that the researcher encountered during his research over such an extended period of time.

On page 8 the candidate wrote: "This change resulted also in the change of terminology: development aid turned into development co-operation, and the target group of aid became a co-operation partner." Actually it was a change in paradigm that led to a change in actions; that in turn led to change of terminology. It is not very clear as such from this passage. The paradigm shifted from hand-out to hand-up, and there are many donors that still do not realize this. On page 70 he asks amongst others the question: Is the intended purpose of ICT realistic also from the perspective of the investor? In the same breath he could have asked if the intended purpose of ICT realistic from the perspective of the end-user, the student/lecturer?

2. Knowledge of literature
The candidate touched on most of the relevant aspects relating to this project. He integrated the literature well and presented it as a whole.

From my own perspective, there is one aspect that I would have like to see integrated into the literature, as well as into the analysis. This is the aspect of the needs analysis for the end-users. Very little come through of their perspectives and needs for tertiary education. Their

circumstances get improved, but they did not have much of a voice in what they wanted to be bettered, or how they will be trained to use the new technology to ensure the optimal use of the technology.

3. Organization of thesis
The thesis is well and logically organized and presented according to the main research questions. The thesis naturally flows from the one section to the next and systematically the analysis is presented as such.

4. Independency and originality
Chapter 5 clearly describes the candidate's effort and independence and originality of seeing this project through. Valuable work was done and the candidate walks away with a wealth of expertise for the future.

5. Presentation of results
The results are presented in a well-structured manner and often with appropriate illustrations. On page 2, Figure 6, the candidate speaks about male and female enrollment, but the graph only illustrates the total enrollment. Not necessary, but it would have been nice to see lines indicating male and female enrollment as well.

I feel that the candidate has done very well to represent so much information in so few pages. This is due to good structuring of the thesis.

6. Clarity of expression
I am taking into consideration both the technical, as well as the English second language barriers of writing this research report. I know not easily obtainable in Finland, an English first language speaking editor might have helped with very difficult sentence constructions. But on the whole the candidate manages to express his thoughts.

7. Merit of technical presentation
Many, clear and well annotated diagrams are included that visually explains many intricate technical aspects. Also the flow diagrams lead the reader through the time frames. However, some of the illustrations can be a little neater in terms of starting and ending points of lines. But these are minimal and on the whole, technically a good piece of work. The page layout is also well formatted.

The candidate and the supervisor should be congratulated with a project well performed, in spite of many problems so typically when Southern and Northern hemisphere cultures meet and address the same issues. On behalf of the people of Tanzania I wish to thank you for your effort.

Verbal review of Jarkko Suhonen

In his thesis, the candidate analyses development process of an ICT Project at Tumaini University/Iringa University Collage, Tansania. The thesis covers four years development period from 2000 until 2004. The candidate ties his work methodologically to action research, which is a natural choice since the author had a crucial role in the development process itself.

The structure of the thesis is coherent and well balanced. The candidate states several research questions and subsequently uses various methods to answer the specified questions. The

author uses figures informatively to present the structure of the thesis and its parts. This helps a reader to grasp the overall development process and different phases of the process. The introduction section, however, is quite short. I would have liked to see more extensive description of the upcoming chapters. This would have helped the reader to prepare for the extensive content of the thesis.

The thesis is firmly embedded to the development context; the author presents in-depth and rich description of the development process. It might have been difficult for an outsider to make some of the key observations and conclusions. Despite of the insight analysis, the author has managed to find a good balance between detailed and abstract presentation.

Clearly, the main merit of the thesis is that it covers a long-term ICT development process (in total four years). This is exceptional in master's thesis level. Furthermore, this type of research is internationally rare. As a result of his work, the author manages to identify key issues that are relevant to similar development cases in other contexts. The work was also done very independently.

The author presents an action research cycle in Figure 4 as a methodological base for the thesis. It would have been clearer, in my opinion, if the candidate had used the presented cycle explicitly throughout the thesis. This might have helped to grasp the overall learning process of the project more precisely. In conclusion, the candidate has done very good job in analysing an important and successful ICT development process in a developing country context.

For the grade we propose: *eximia cum laude approbatur*

Master's Essay (173242) for the thesis has been approved on September 27, 2005.

Joensuu and Pretoria, South Africa, January 4, 2007

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Acronyms and Abbreviations

AD	Active Directory
CD-ROM	Compact Disc – Read-Only Memory
DBMS	Database Management System
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
ELCA	Evangelical Lutheran Church in America
ELCT	Evangelical Lutheran Church of Tanzania
FELM	Finnish Evangelical Lutheran Mission
FIM	Finnish Mark
FPP	“Four-Point Plan”
ICT	Information and Communication Technology
IFIP	ICT Facilities Improvement Project
IPSP	Internet Project Strategic Plan
ISP	Internet Service Provider
IUCO	Iringa University College
KCMC	Kilimanjaro Christian Medical College
LAN	Local Area Network
MUCO	Makumira University College
NGO	Non-governmental Organization
TCC	Tanzanian Communication Commission
TEL	Technology Enhanced Learning
TTCL	Tanzanian Telecommunication Company Limited
UPS	Uninterruptible Power Supply
VSAT	Very Small Aperture Terminal
WINS	Windows Internet Name Service
WWW	World Wide Web

1. Introduction

When the international development aid started in the late 1950´s, its aim was to modernize the so-called underdeveloped societies. Its leading principle can be summarized as follows: the professionals of western societies know best, how a modern society functions and the quickest way of modernizing is to lend money to and provide the best professionals for underdeveloped countries' use. Only later, in the 1970´s, questions of equality and one's right of defining its own development became topics of discussion. The reason behind this shift of paradigm was the lack of expected results. [45]

One of the most important reasons for failure was the lack of participation of those people who were the target groups of aid. Due to this, concept of participation has then been extended to all activities done in the development work. This change resulted also in the change of terminology: development aid turned into development co-operation, and the target group of aid became a co-operation partner. On the 2000´s, the central themes in development work have been democracy and human rights. Developing a strong civil society is seen as a fundamental precondition of manifestation of democracy. In practice, developed countries want to support such processes that enable citizens of developing countries to participate more fully in discussing, setting the goals and making decisions in their societies. [45, 53]

Nowadays the development co-operation is seen as a partnership, where both parties learn from one another in the process of collaboration. It presumes that people, who are part of it, respect one another's know-how. [53]

This research grows from the aforesaid background where questions of development co-operation and partnership play a key role. It aims at casting light to problems that arise in an ICT project; the perspective is one of a western professional's. The researched project took place in Tanzania.

The research is structured as described in Figure 1. The methodology is based on an action research and is explained in the Chapter 2, together with research questions. Chapter 3 summarizes some of the key questions about ICT and its position in global development co-operation. It describes the larger context where the research took place. The implemented ICT

project is studied as a learning process in Chapters 4 and 5, and evaluated in Chapter 6 by using quantitative methods. Chapter 7 includes all the research results of the project. Finally, Chapter 8 summarizes the lessons learned from the ICT project in a larger context.

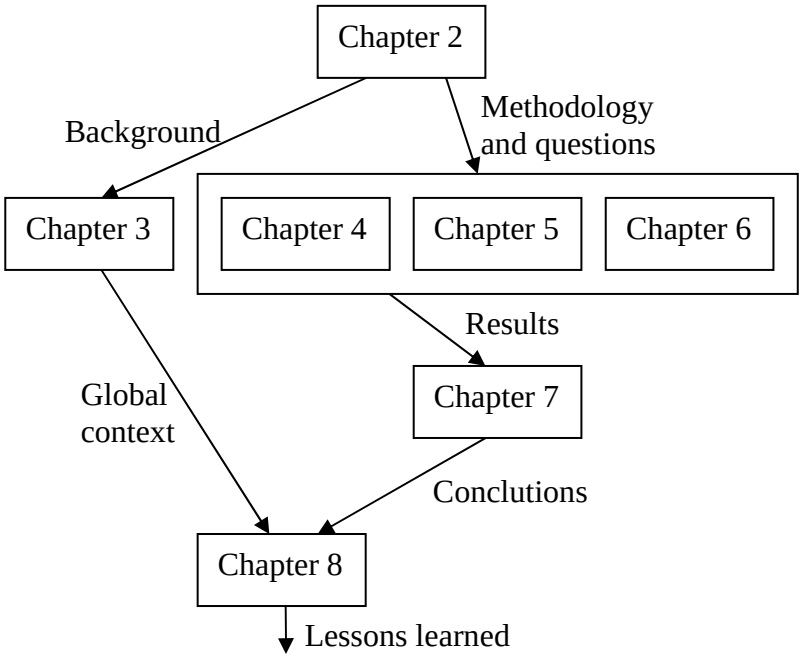

Figure 1: The structure of the research.

2. Research questions and methods

Tumaini University/Iringa University College (more about the college in the chapter 4.1) has been implementing an ICT project called *Internet Project Strategic Plan* (IPSP) since year 2000. The aim of IPSP was to create a stronger learning environment through the use of ICT. The project was planned together with Finnish Evangelical Lutheran Mission's (FELM), Evangelical Lutheran Church of America's (ELCA) and Iringa University College's (IUCO) personnel and it was divided into separate subprojects for the implementation (Figure 2). The project implementation was funded mainly by FELM, who included some of the subprojects in the Finnish government funded program for development co-operations. [2]

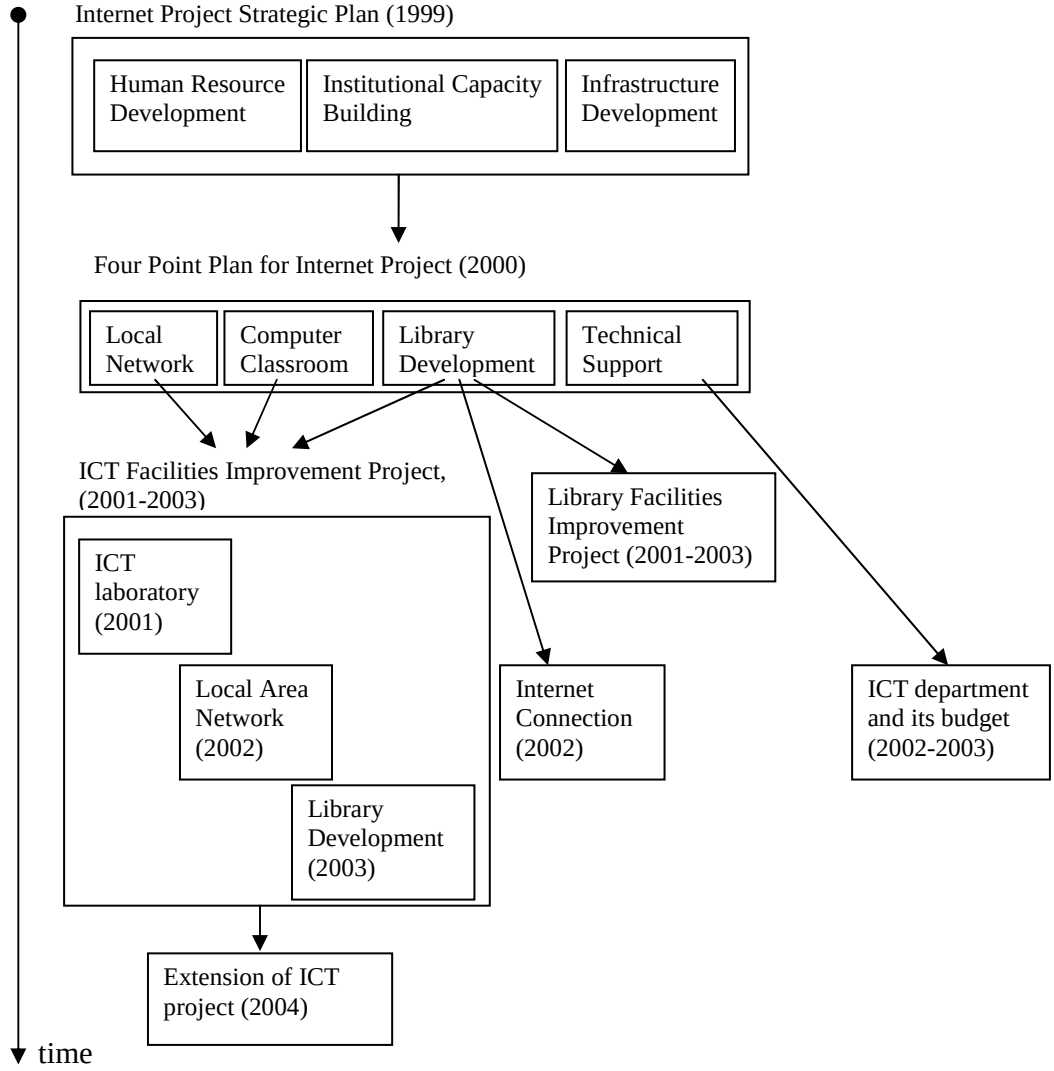

Figure 2: The implementation process of Internet Project Strategic Plan in 2000-2004.

The purpose of this research is to analyze IPSP and its implementation activities in its cultural context in 2000–2004. The project took place in a three-dimensional cultural network in Tanzania, where in addition to Tanzanian culture and environment, also US and Finnish influence were present (Figure 3). It is a generally known fact that immigration to a foreign country causes cultural stress because in the utmost case, all elements of every day life change: language, way of living, religion and societal values. Cultural adaptation process can be divided into four phases: honeymoon, crisis, reorientation and adaptation. In honeymoon phase, all new and different seems interesting and positive. In crisis phase, nearly everything in a new culture annoys. In reorientation phase, situation is accepted and one starts seeing positive aspects in the situation. In adaptation phase, one sees him/herself as part of the current environment. The speed of this process is individual and it is affected by many factors whereby one of the most important is the learning of local language. [56]

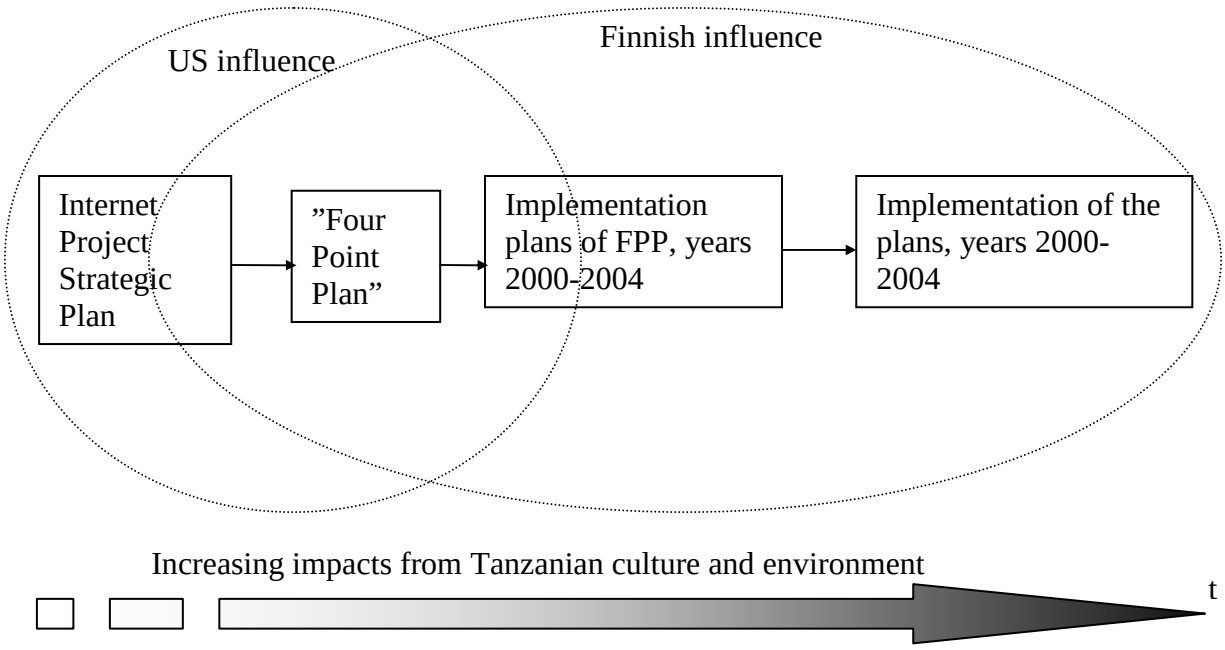

Figure 3: Study/research design.

In the light of the above mentioned adaptation process, the impact of Tanzanian culture and environment increased while the project proceeded, because the key implementers were processing their own cultural adaptation. Therefore the main questions of the whole research are:

1. What were the design and implementation processes of IPSP?
2. How did the implementation of IPSP achieve its original goals?
3. Was IPSP successful in relation to the expectations of Iringa University College?
4. What can be learnt from IPSP in larger context?

The first question - what were the design and implementation processes of IPSP - is answered in Chapters 4 and 5 by introducing the context of the project and reviewing its design and implementation as a learning process. The methodology is described more precisely later in this chapter.

The second question - how did the implementation of IPSP achieve its original goals - is answered in Chapter 6 by evaluating the project in the light of quantitative analysis. The quantitative evaluation of the project is done by comparing the available ICT resources in 1999 and 2004. Also the planned timetable and the budget of the project are compared to the materialized ones.

The third question - was IPSP successful in relation to the expectations of Iringa University College - is answered in Chapter 7 by concluding the results of the evaluation (Chapter 6) in the light of the described learning process (Chapters 4 and 5).

The fourth question - what can be learnt from IPSP in larger context - is answered in Chapter 8 by bringing together all those factors that affected the design and implementation process of this development project.

In Chapter 3 the research is connected to the global development co-operation, which is the larger context where the researched project took place. It answers the question: what is the position of ICT in global development co-operation? Finally the research is connected to its environment by summarizing the role of ICT in the educational sector of Tanzania.

The methodology used in this research is based on an *action research* and the research environment is described in Figure 3. Stephen Corey defines the method as follows: “Action Research is the process by which practitioners attempt to study their problems scientifically in order to guide, correct, and evaluate their decision and actions” [29]. This method is chosen due to the fact that the researcher, Finnish ICT expatriate, was a part of the process. His role varied in the course of the process: in the beginning of IPSP he was an outsider, then his role developed as team member and finally this role changed to a project manager during the implementation. Because of this fact the pronoun “I” is used instead of “he”, “the author” or similar [30].

The scientific foundation of action research is cognitive psychology and constructivism, and the learning process of the researcher can be described as a circle with following phases (Figure 4): the basis where the researcher operates from, consists of his/her acquired theoretical background together with the practical experiences he/she has gained (1). When some activities are then put into practice, the solutions used inevitably grow from that basis. The implementation of activities produce new experiences (2), which are then analyzed. Analysis may result in a conflict with the already existing knowledge (3). Through reflection, process leads to merging together former and new knowledge (1). If needed, the circle can repeat itself several times. [36, 60, 63]

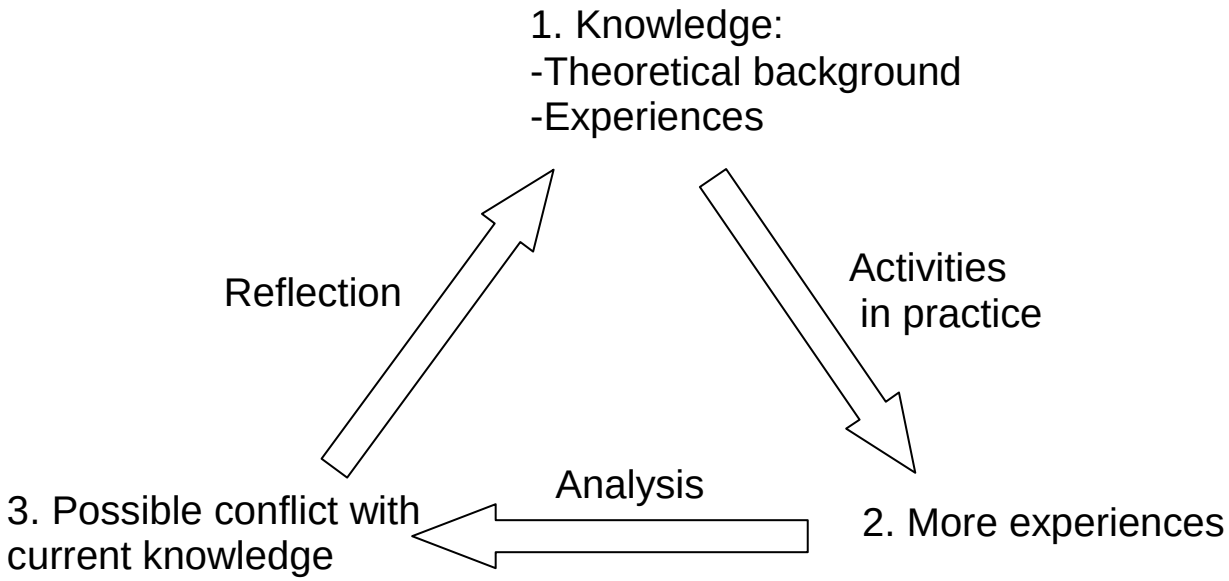

Figure 4: Learning process.

In addition to the fact that the researcher has been part of the researched process, this method is justified due to the observation that the analysis of the contextual elements affecting to this particular project would be almost impossible for an outsider to make. Even if this close connection has been necessary in this particular learning process – this is also in line with constructivist learning theory – it can also be viewed as a double-edged sword: is it possible to retain objectivity when analyzing own actions? It is acknowledged that the close connection to the researched process can hide the original perspective of the research. Therefore, its affects have been minimized by mirroring the results with quantitative analysis. [31, 51, 60]

In the field of computing, the action research method is widely used in the area called information system research, for instance in the process of a new software development [e.g. 25]. Also the method plays a key role in many researches related to the use of ICT in separate areas like education [62].

The references of this research have been categorized as primary sources and literature. Primary sources include all the materials that have been generated in the process of the project, such as emails, plans and other first hand documents. Literature consists of second hand sources such as policy documents, manuals, articles and other scientific publications. They were selected by their relevance to the topic, and keywords used in the selection process were such as ICT, development project(s), developing country/countries, ICT and poverty, and ICT and education.

3. ICT and its position in global development co-operation

In this chapter the position of ICT in global development co-operation is approached firstly through the general context of international development politics. Role of ICT in development co-operation, various international operators and political thinking affecting the use of ICT are considered. Secondly, the variety of ICT projects in developing countries and ways to measure the use of ICT are introduced. The question of the sustainability of ICT projects is discussed. Thirdly, factors hindering the use of ICT in developing countries are brought up. Finally, the role of ICT in Tanzanian society, especially in the educational sector is analyzed.

3.1. Sustainable development

Sustainable development is a core concept in global development co-operation. In 1987 United Nation's commission *World Commission on Environment and Development* published a report called "Our Common Future" - also known as "Brundtland Report" – where sustainable development was defined as follows: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [75]. Even if this definition was widely accepted on the global political level, the precise meaning of sustainable development was widely debated [55].

Problems with the precise meaning of the term led to many separate sub-definitions depending on the organization's position in the global community. The most important definition for global development co-operation was given by the World Summit on Social Development in 1995. It defined the sustainable development to be "the framework for our efforts to achieve a higher quality of life for all people", in which "economic development, social development and environmental protection are interdependent and mutually reinforcing components"'. This definition was expanded in 2002 identifying the "three overarching objectives of sustainable development" to be eradicating poverty, protecting natural resources, and changing unsustainable production and consumption patterns. When we focus on the global development co-operation, sustainable development can be approached through four dimensions of sustainability: environmental, economical, social, and cultural (Table 1). [53, 75, 76]

Table 1: Four dimensions of sustainability.

Environmental	**Economical**	**Social**	**Cultural**
- Development is in harmony with the ecological processes. - Development does not affect biodiversity. - Natural resources are used only as much as they replenish naturally.	- Development is financially efficient and competitive. - Development takes care of the needs of future generations.	- Development strengthens the quality of life of society as a whole. - The results of development are shared equitably.	- Development is in line with stakeholders' culture.

The dimensions of sustainability (Table 1) have to be included when designing and implementing any development project. When analyzing how sustainable project is, the following ten key factors are normally noted: [53, 76]

1. *Participation and ownership*. The beneficiaries and other stakeholders should participate in design and implementation phases and the project must build on their initiatives and demands.
2. *Capacity building*. The project should strengthen the capabilities of civil society including knowledge and skills.
3. *Government policies*. The project should be in line with local government policies.
4. *Financial*. Sufficient economic and financial basis for long-term functionality.
5. *Management and organization*. Sustainable basis for institutional capacity to operate, maintain and manage the systems.
6. *Society, gender and culture*. The understanding of local decision-making systems, gender divisions and cultural preferences.
7. *Technology*. The technology must be selected with the local capacity to maintain equipment and buy spare parts.
8. *Environment*. The environmental risks should be analyzed.
9. *External political and economic factors*. The projects should not be too complicated, ambitious or expensive.

10. *Realistic timetable*. Short projects may be inadequate for solving entrenched problems in a sustainable way and long projects may promote dependence.

The aim of the aforesaid analysis is that the positive impacts of project would be permanent. Also the analysis reduces the subsequent social problems, such as dependence of the stakeholders on external donors and their resources. This means that all development assistance, apart from temporary emergency and humanitarian relief efforts, should be designed and implemented with the aim of achieving sustainable benefits. [53, 76]

3.2. Role of ICT in development

Information and Communications Technology (ICT) can be defined as all the technology that facilitates the processing, transfer and exchange of information, and communication services. In the 1990s with the rise of the Internet, ICT was seen as a formidable tool to close the gap between the developing world and the developed world by skipping certain stages of industrial development. This has also been criticized, because it emphasizes the key role of technology in development [49]. However ICT can have a dramatic impact on achieving specific social and economic development and it definitely plays a key role in broader national development strategies. Capitalizing on the opportunities of ICT depends not only on the availability of ICT services, but also how well they are utilized in various sectors of the countries' economies [68].

The role of ICT and the expectations and demands set to it in a context of developing countries depend greatly on the poverty reduction strategies defined by the aforesaid countries. Those strategies, named as poverty reduction strategy papers, have been formulated in line with the definitions set by World Bank in the beginning of the 2000´s, when also United Nations set its Millennium Goals. It is a question about a joint policy that all development workers should take into consideration. There are various emphases in national strategies according to the strengths and weaknesses of particular countries; therefore it is difficult to make generalizations about the role of ICT or any other technology in a worldwide perspective. [74]

The poverty reduction strategy papers have therefore impact on the activities done by governments of developed countries. For instance, Finnish government has specified some

general principles for its development work in line with the paper. The aim of the development work done by Finnish government is to promote economical growth and societal development of developing countries. Due to this, development work has become part of foreign policy, not international aid as one might expect. [53]

Development work done by Finnish government covers the following general goals: reduction of widespread poverty, prevention of global environmental problems, promotion of human rights and democracy, promotion of global security, and promotion of economical dialogue. In addition to those, there are three cross cutting themes: reducing gender inequality, improving the condition of vulnerable groups, especially people with disabilities, and sustainable development. [53]

Although the specified principles and themes are related to Finnish government development work only, through them we can identify more global thinking in this field. The basic question arises: has technology something to do in putting the above mentioned principles in practice? It is hard to find an unequivocal answer, however it is clear that technology can not have any other but an instrumental role. Technology can be utilized in reaching the development goals, but as such and per se it does not have a purpose. [65]

Such international agencies, where the developed countries have gained too much weight in relation to the population they represent (for example Information Society) have predicted a major role for ICT in development issues. In 2003 World Summit on Information Society set a goal that all people all over the world, regardless of the location, should have equal access to the benefits of modern ICT. Although the goal itself looks excellent, the practical actions can provoke several questions from the perspective of developing countries; one of them could be about the obvious dominant role of the United States or European Union and the ultimate motivation of such societies. [77]

3.3. Range of ICT projects

Existence of digital divide and its consequences for developing countries in global economy is a fact which has been widely recognized. Therefore, various projects on ICT sector are being initiated and implemented on all spheres of life in developing countries. The ongoing and

already carried out projects deal with infrastructure, education, health care, administration, etc. Governments, international institutions, non-governmental organizations, faith-based organizations and private business entrepreneurs are involved in these processes. [39]

Countless number of statistics have been published about the prevalence of ICT. Mostly they describe the prevalence of a certain technology, number of users, or the advancement of a certain technology. Their basic problem is that they are very rarely comparable between different countries, since for instance in Africa the internet cafes are widely spread compared to Europe, and therefore the number of internet users is higher than the number of connected computers in Africa than Europe. Neither do the various indicators of technical infrastructure take into account other important factors that affect the use of internet, such as the rate of literacy or the running expenses of hardware. Also there are remarkable differences within countries and no comprehensive statistics available at all. [38]

In 2003, *International Telecommunication Union* (ITU), an international organization within UN, published a report whereby the factors affecting the accessibility of ICT technologies were analyzed. To represent this, ITU has developed a *Digital Access Indicator* (DAI) which attempts to take into consideration the infrastructure and costs of ICT sector, knowledge and skills of people, the quality, services, and actual level of use of ICT. In the report, ITU divided all the countries of the world into four categories. Among the African countries, only Mauritius reached the first category while for instance South Africa, Botswana and Gabon can be found in the second lowest category. All the other southern African countries fell into the last category. [37]

Development of ICT sector in developing countries and its contribution, for instance, to poverty reduction has been a challenge. The formerly known general problems related to development projects and especially in transfer of technologies can also be found in ICT projects: the focus is often too narrow and does not link to wider context; the sustainability is not taken care of when the external funding comes to its end; projects are too often planned on donors´ terms and they do not integrate in societies; new technology is underutilized due to the lack of skills when the dependency on foreign experts grows. [65]

Use of foreign experts in ICT projects is problem not only from the perspective of dependency. The question also arises, how an expatriate from an industrialized country is

equipped to encounter another culture and context – how the negative impacts of cultural stress are minimized? One way to approach this is a so-called CATI-model (Contextualize, Apply, Transfer, Import) developed in the University of Joensuu. This four level model is aimed to be utilized for analyzing the planning and implementation processes of sustainable ICT projects in developing countries. [73]

The questions of use and role of technology in various development projects have been mentioned in several studies.[1] The most representative summary is found in article *The Challenges of Technology Research for Developing Regions* [26], where the practical problems and their solutions are presented. The variety of listed problems is large and they have been divided into three categories: technical, environmental, and cultural challenges. The observed problems, their reasons and solutions are summarized in Table 2. This categorization is useful from the perspective of implementation of a technical project, but it does not take into consideration the wider social context and background. This field is a challenge on its own, and is analyzed in Chapter 3.4.

[1] See for example [26, 27, 28, 42, 44, 46, 47, 48, 49, 58, 64, 65, 66, 67, 68, 73]

Table 2: The challenges of technology project.

Challenges		Reasons	Solutions
Technical	Equipment failures	Humidity, heat, dirt and dust, water, ultraviolet exposure, bumpy roads	Better equipment, cooling, cleaning
	Power problems	Outages, spikes, brownouts	UPS, laptops
	Software infection and reinstallation	Spyware, viruses, worms	Reinstallation, reconfiguration, Linux instead of Windows
	Remote management	Bad connection, lack of power at the scheduled time, hung nodes, misconfiguration	Reinstallation CD with settings
Environmental	Transportation	Travel time and costs, accidents	Reliable equipment, remote management
	Custom and shipping	Delays, clearing customs	Bring them as luggage, shipment in advance, local purchase.
	Local purchase and manufacturing	Timetable, quality	Knowledge about the local situation
	Urban danger	Informal authorities: local gangs, drug lords	Local knowledge
	Natural disasters	Destroyed infrastructure	Combination of relief work and unplanned research
Cultural	Staff and training	Shortage of ICT personnel, lack of qualified ICT staff, high ICT staff turnover	Detailed training manuals, web-based user interface for viewing and modifying the configuration, staff training
	Tampering and theft	Equipments disappearing	Equipment donations, local guard
	Corruption	Extra fees	Emphasize social responsibility
	Illiteracy	Illiteracy rate about 50% of the total population	No good solution, speech recognition.

3.4. Trends hindering the use of ICT

Even if it is sometimes justified to ask questions about the motivation of some development activities, it is also self evident that developing countries have a right for access to ICT and there are at the moment number of projects aiming at bringing ICT in various sectors in developing countries. When comparing the situation between developed and developing countries, it is possible to categorize at least three main trends in developing countries that are delaying the use of ICT there. [41]

The first trend is simply *lack of resources*. The difficulties in this category are related to the personnel and funds. ICT is expensive to purchase, qualified technical staff are required to keep equipments operational and the users must be trained for utilizing the tools. ICT can only flourish where the capacity to provide and maintain ICT infrastructure at a reasonable price in a sustainable way exists. ICT is a high tech discipline, which requires advanced capacities from the employees who are utilizing it. [42, 46, 50, 65]

All factors listed as technical challenges in Table 2 belong to this trend. In addition to this, also local purchase which was listed as environmental challenge, and staff and training that was listed as cultural challenge, can be included here. Rests of the listed factors belong clearly to the second trend.

The second trend is related to *the working environment*. The factors in this category affect people and technology on general level. The most important group here is the low level of infrastructure, such as the lack of power lines. Irregular or non-existent electricity supplies are a common feature and a major barrier to the use of the ICTs, especially outside the major towns. Many countries have extremely limited power distribution networks, which do not penetrate significantly into rural areas, and regular power outages for many hours are common occurrences. [42, 50]

The road, rail and air transport networks are limited, costly and often in very poor condition preventing the increased movement of people and goods, needed both during the implementation of ICT projects in rural areas and later delaying the support for keeping an ICT infrastructure operational. Complicated immigration rules and visa requirements for foreign experts add to these difficulties. Other very important factors among the infrastructure

which should not be underestimated are available official services like banking and health care. [26]

A stable political situation is one of the most important requirements for introducing ICT in developing countries. Governments make the laws and framework in which the different organizations have to operate. Unstable political situation introduces a lot of hazards and risks, for instance frequent changes in tax raises, disapprobation by law, and import/export embargos. [48]

Corruption does exist in nearly every country, but its grade in developing countries is higher than in developed countries. The index ranges between zero and ten, where ten indicates a country being totally free from corruption, and zero indicates that the country is highly corrupt. For the developing countries, the situation is not very flattering, since the most of them have scored less than 3.0. The most of the African countries are found at the bottom, for example Kenya is at place 142 (score 2.2) and Tanzania is at place 93 (score 2.9) of the 160 countries included in the survey. [69]

The third trend can be found when comparing *the needs of different cultures* [66]. ICT and its' education is designed for markets in developed countries and contextualization is needed when this know-how is transferred to developing countries [58, 67]. It is not only a question about how to transfer ICT from the developed countries to developing countries, but also how to implement the transfer. The contextualization of ICT is a key issue in improving developing countries' economies and it will have a continuous effect in the future [27]. This contextualization is a challenge and it has to be done in co-operation with people of developing countries [47].

However it is not possible to ignore the importance of ICT for developing countries, because it provides immediate access to up-to-date information around the world and the availability of information is a critical element for the development in all countries. This is an area where developing countries are at a disadvantage in relation to developed countries because of their current level of technical development. [40, 50]

For developing countries, it is urgent to get ICT to the sectors of the economy where the introduction will have the greatest influence on general national development. The African

population pyramid has a different shape than in Europe. In Africa, over 42 percent of the population is younger than fifteen years old (In Europe 16%) [72]. This means that the African populations have a very high rate of youths that need education, compared to the number of adults available to provide that education. At the same time, the governments of the developing countries are well aware of the importance of education for poverty reduction and they will therefore be willing to invest in this area. Because foreign aid agencies share this interest, the education is a high potential area for getting support [74].

Furthermore, the course materials used for education must be relevant in the local cultural and social context [66]. Development or adaptation of this material should therefore be done locally. Africa is, because of this, in need of organizations dedicated to convert American and European educational material to fit the African context [48, 50, 64].

3.5. ICT and education in Tanzania

The vision of Tanzanian's national information and communications technologies policy from year 2003 is summarized in the following statement: "Tanzania to become a hub of ICT Infrastructure and ICT solutions that enhance sustainable socioeconomic development and accelerated poverty reduction both nationally and globally". This policy is based on to the Tanzanian Development Vision 2025 and they both emphasize the key role of ICT for the national development [52].

ICT policy summarizes the ICT situation in the country including the political process with the liberalization of the telecommunication sector, availability of Internet connections, lack of hardware and software manufactures with a few exceptions, the under use of open-source software, etc [52].

The most important area covered in the policy from this research point of view is the educational sector. The policy states clearly that only a few educational institutions have computer laboratories or other multimedia facilities. There is a lack of programs for training teachers on ICT and its utilization in education and they are pointed to be as a major reason for slow take up of computer studies in primary and secondary schools. Also the country does not have ICT professional profiles with a standardized process of evaluation or certification of

the different courses offered by various educational institutions. This was seen as a reason for a shortage of well-qualified ICT professionals of ICT in Tanzania [52].

Even if ICT's importance has been recognized on the governmental level in Tanzania as explained above and despite its' rapid development there, the modern information and communication technology is not widely used for learning in educational institutions of Tanzania [52, 54]. This fact was a motivator for an ICT project in Iringa, which is analyzed in following chapters.

4. Designing of the ICT project in Iringa

The analysis of the ICT project is here divided to two separate phases: designing and implementation. This division is based not only on the project cycle, but also because the US influence on the project was present in the designing phase only (Figure 3, p.4). These both phases had their sub-phases where the experiences from the previous phase had impact on the next phase (Figure 4, p. 6).

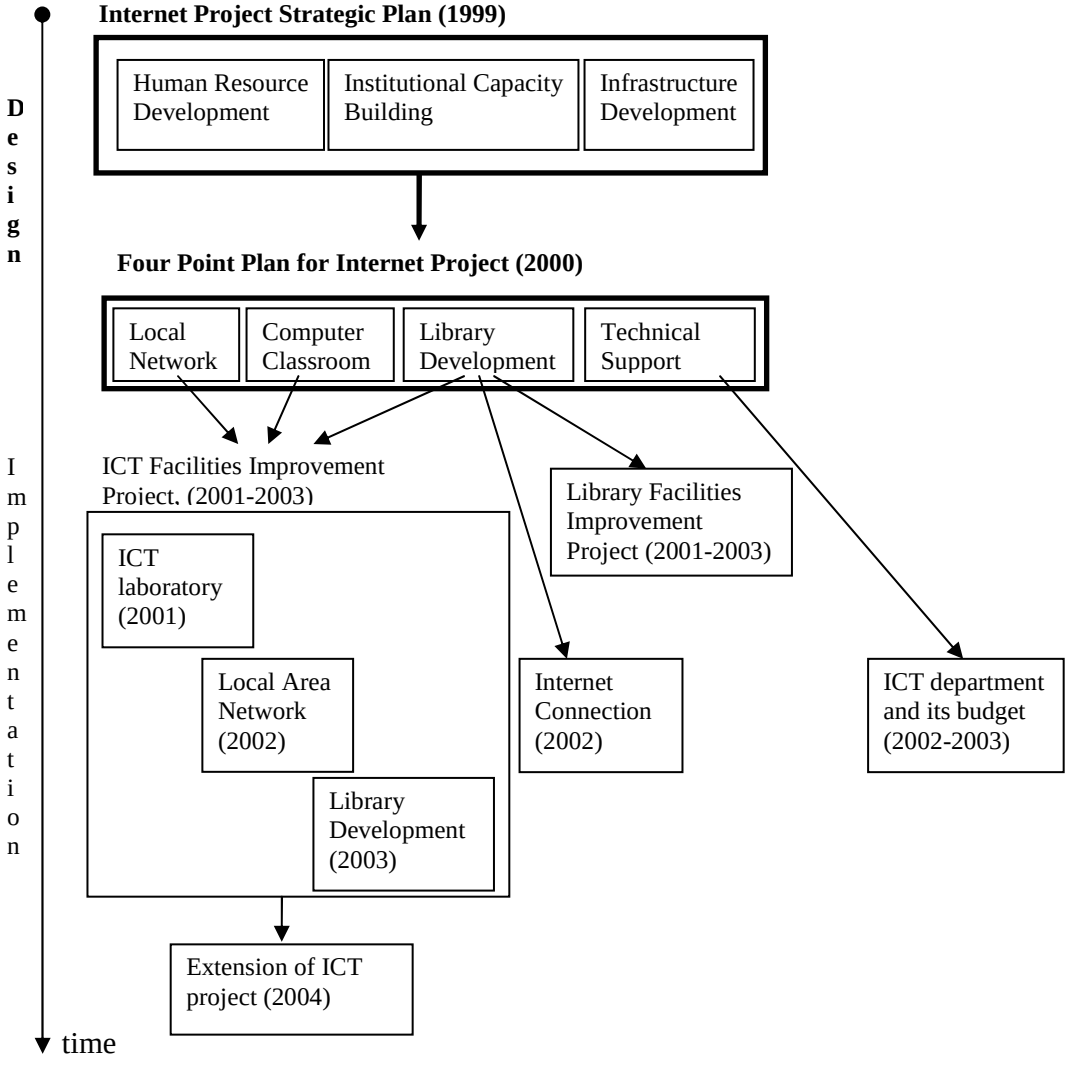

Figure 5: Sub-phases of the design process: *Internet Project Strategic Plan* and *Four Point Plan for Internet Project*.

In this chapter, the facilitators of the project are introduced together with the background situation in terms of level of ICT facilities at Tumaini University/Iringa University College in year 1999. After that the sub-phases of the design process are reviewed, including their impact on the next phase. The sub-phases of the design process are the creation of a general vision called Internet Project Strategic Plan, and a plan for its concrete implementation called Four Point Plan for Internet Project (Figure 5).

4.1. Tumaini University/Iringa University College (IUCO)

4.1.1. Establishment and situation in 2004

In 1990's Tanzania liberalized its educational sector and the establishment of the private universities became possible after the subsequent enactment of the Education Act No. 10 of 1995. In the effort to improve not only the possibilities of ICT in education, but also to contribute to the higher education in Tanzania in general, the Evangelical Lutheran Church of Tanzania (ELCT) founded Tumaini University in 1996 [33]. Tumaini University consists at present of four constituent colleges: Iringa University College (IUCO), Kilimanjaro Christian Medical College (KCMC), Makumira University College (MUCO) and Waldorf College in Dar es Salaam [70]. This research focuses on IUCO, where the researched ICT project took place (see Chapter 2).

IUCO is the successor of the former Lutheran college at Iringa which was opened in 1993 [70]. It is located on the north edge of the town of Iringa in the southern highlands region of Tanzania. Iringa town is the capital of the Iringa region and its population is about 110 000 (2003).

IUCO is the largest college of Tumaini University and offered degrees in four different faculties (2004): Theology, Law, Business and Economics, and Arts and Social Sciences. Faculty of Arts and Social Sciences included two departments which are Journalism and Education. [71]

IUCO's student enrollment increased about 30% annually during years 2000-2004 (Figure 6) and it was about 670 students, in academic year 2004-2005, including students from every region of Tanzania and from the countries of Kenya, Malawi, Burundi and Botswana [71].

The percentage of female students was approximately 40% during the above said period and it was significantly high compared to the government owned universities in Tanzania (for example, University of Dar es Salaam had 26% in 2000/2001) [28].

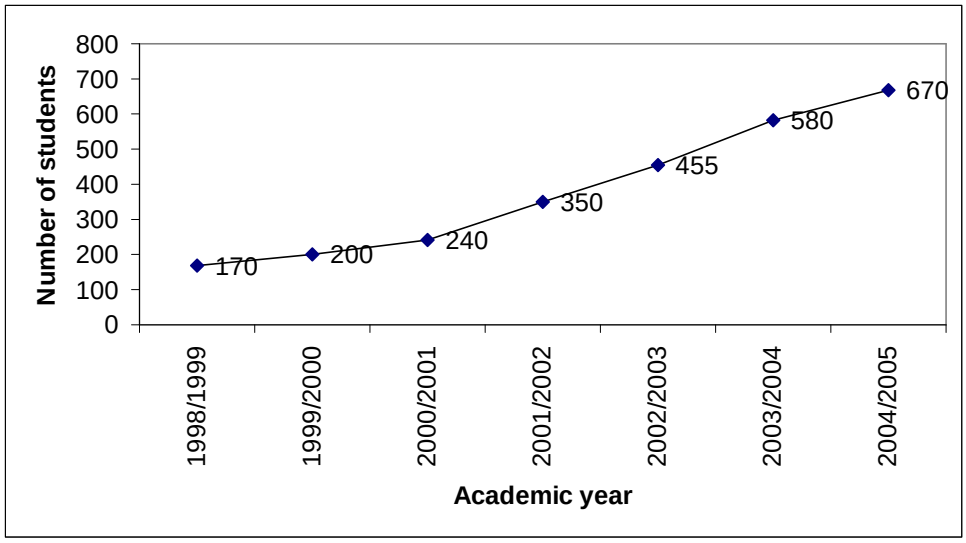

Figure 6: Number of students in 1998 – 2004.

Tumaini University is a private institution; therefore it does not receive any funding for its development from Tanzanian government. Also the individual colleges of Tumaini University are financially independent and therefore all of IUCO's income comes through student fees and various donors [24]. Its organization was build hierarchically as described in Annex A.

4.1.2. Co-operation partners

IUCO's main donor organization since its commencement has been the Evangelical Lutheran Church in America (ELCA). It is the largest Lutheran church in the United States of America, with more than 5 million members. During the past 10 years it has been supporting IUCO's construction activities, sending teachers, administrative staff and volunteers for the college. Also ELCA has been contributing indirect support to the college through its scholarship program. Furthermore it has donated direct material support to the college, e.g. books and secondhand computers. [32]

Besides ELCA, another main co-operation partner has been The Finnish Evangelical Lutheran Mission (FELM), which is the largest mission agency of the Evangelical Lutheran Church of

Finland. It had about 240 missionaries working in twenty one different countries in Africa, Asia, Europe and Latin America in 2004. FELM as an organization was founded in 1859 and it commenced its work in Tanzania in 1948 [34]. FELM has provided direct financial support for some construction activities and it has also been recruiting qualified Finnish teachers and staff for different faculties' use. Also it has provided indirect financial support through scholarships and it has included some of IUCO's projects in its Finnish government funded program for development co-operation of non-governmental organizations (NGO). An important part of these Finnish government funded projects has been IUCO's plan to develop ICT teaching and ICT facilities for teaching [35].

The Finnish government has a principle that 10-15% of its development assistance for development co-operation should be channeled through Finnish non-governmental organizations. Also the ministry has a special agreement system called Framework Agreement System for some large and experienced NGOs. This system gives more flexibility to NGOs in their projects and defines the principles as well as project-specific frames for a four year period at time. FELM is one of those organizations who have signed the agreement with the ministry. [53]

4.2. ICT situation in IUCO at the beginning of the project

In the beginning of 1999, IUCO had eighteen 486/386-level computers with Windows 3.1/Microsoft Office 4.2 –software combination and twelve matrix printers for its students, teachers' and staff use (Table 3) [14]. The students' computers and printers were allocated in an ICT laboratory for teaching purposes, writing assignments and thesis. The staff computers and printers were allocated to different offices in the administration building and library. The library's staff had a computer for writing documents and entering information to the Microsoft Access based library database management system (DBMS). Library DBMS was designed by a volunteer from the Christian Reformed World Relief Committee and due to its simplicity its aim was only to begin the process of creating an electronic list of library's holdings [57].

Table 3: ICT facilities available for IUCO's staff and students in 1999.

Item	January 1999	December 1999
Computers for staff	8	18
Computers for students	10	30
Printers for staff	8	8
Printers for students	4	4

Later in 1999, all 386-level computers and Windows 3.1/Microsoft Office 4.2 –software combinations were replaced with the donated 486-level computers and Windows 95/Microsoft Office 95 [14]. During this time period two new ICT laboratories were opened in the new library building and the old laboratory was allocated for normal teaching activities. These laboratories contained totally twenty eight computers and they were used in a similar way as mentioned earlier [2]. Two of the students' computers were installed for journalism students' use in the new laboratory for publishing magazine called Tumaini Hill.

Until the year 1999, ICT education and support were taken care of by western volunteers. They stayed in Iringa only for short periods; the longest period to stay was one year. This did not allow them to develop any long term objectives on ICT field for IUCO. The situation improved, when I started my first four years working period in 1999.

4.3. Internet Project Strategic Plan

4.3.1. Framework for the use of ICT

Internet Project Strategic Plan (IPSP) from year 1999 defined the general vision, goals and objectives for development of IUCO's ICT activities for the following years. The IPSP's vision emphasizes that the internet and computers will be vital components for learning and teaching in the future. Its goal was to get IUCO connected to the internet as soon as possible. The plan was structured to phases (Figure 7) and each phase was planned to be implemented before the following one. [2]

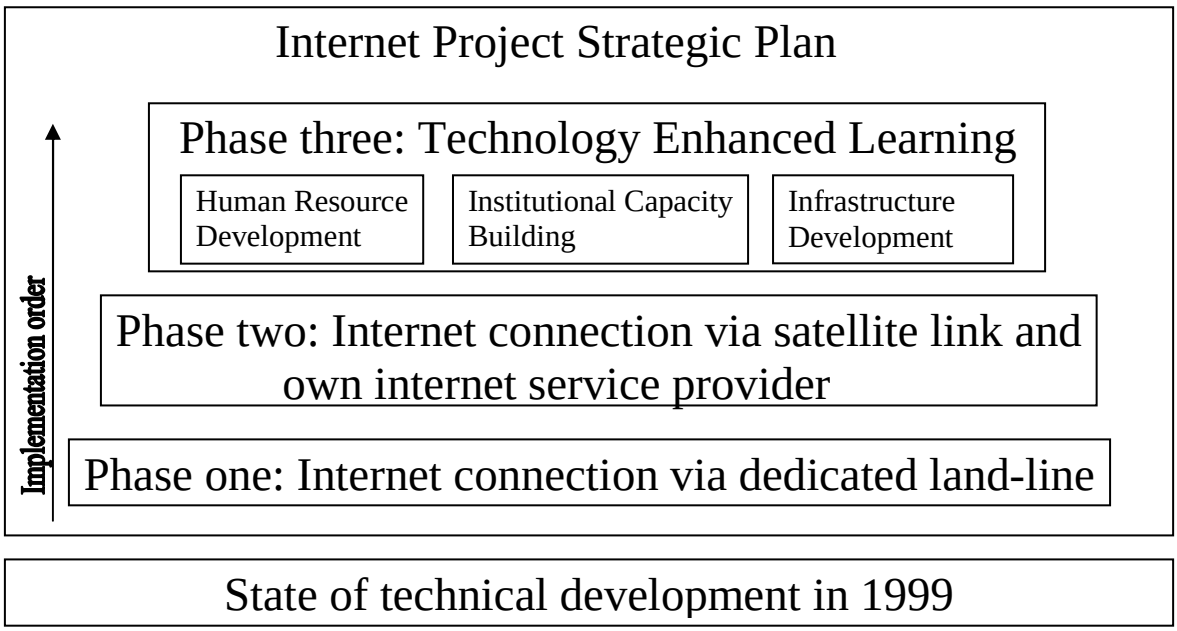

Figure 7: Phases of IPSP.

In the beginning of the plan, the state of the ICT development in 1999 at IUCO was analyzed from the technical perspective. Then it introduced two options how to get IUCO connected to internet. The final phase (Technology Enhanced Learning) introduced some ideas of how IUCO should use ICT in its education in general. It was divided to three independent areas (Table 4)*: Human Resource Development*, *Institutional Capacity Building* and *Infrastructure Development* [2]

Table 4: The areas of Technology Enhanced Learning.

Human Resource Development	**Institutional Capacity Building**	**Infrastructure Development**
- Faculty Development	- Library Development	- Local Linkage
- Staff Development	- Curricular Exchange	- Regional Linkage
- Students Skills	- Internet Assisted Courses	- Disciplinary Consortium
	- Computer Science Department	- African Studies
	- Language Development	- Local Service

The goal of the sub-areas of *Human Resource Development* was simply to train all members of IUCO's staff to use ICT facilities in their duties as effectively as possible [2]. The second main area, *Institutional Capacity Building* included five sub areas. "Library Development's" aims were to modernize the cataloguing system in Library, create contacts to other university

libraries, increase the use of CD-ROMs, and provide access to on-line journals, books and databases. “Curricular Exchange” covered distance learning and curriculum development activities in co-operation with other universities. “Internet Assisted Courses” offered the possibility to IUCO’s students to study some courses outside of the classrooms. “Computer Science Department” introduced the idea of the establishment of the department of computer science. “Language Development” included use of the internet and CD-ROM technology to exchange students’ language acquisition. [2]

The third main area in phase three, *Infrastructure Development* was divided to four sub areas. “Local Linkage” included co-operation with local educational institutions. “Regional Linkage” extended "Local Linkage” to other universities and colleges in Tanzania and its purpose was to share information. “Disciplinary Consortium” covered the same area as regional linkage, but world widely. “African Studies” dealt with the idea of developing African Studies degree program under the Faculty of Arts and Social Sciences in co-operation with other African universities. “Local Service” gave a plan to start Internet Service Provider in Iringa and develop short commercial ICT courses for outside clients. [2]

4.3.2. Impact on the design process

Mr. Richard Ashford, a volunteer employed through ELCA, assisted IUCO to develop the plan for its future ICT activities. He stayed in Iringa during September 1999 – April 2000 and introduced the IPSP. The plan was developed to serve as the basis for requesting funding and published in October 1999 – a month after his arrival to Iringa. The second phase in the plan, own Internet Service Provider, was added, because of the lack of the commercial internet service providers in the Iringa region at that time. [2, 5]

Even though the plan defined the general vision, goals and objectives for IUCO’s ICT activities, it only summarized the current ICT facilities of IUCO without analyzing their use, quality or quantity compared to the students’ body or staff. It was realized soon after its publishing that it was not concrete enough for fulfilling its purpose (to serve as the basis for requesting funding) and this conclusion pointed out that a more concrete plan had to be created. The discussions led finally to the creation of a new plan, called Four-Point Plan for Internet Project, introduced in the next chapter [5].

4.4. Four-Point Plan for Internet Project

4.4.1. Content of the plan for ICT development

Four-Point Plan for Internet Project (FPP) from year 2000 introduced and identified four key areas where the implementation activities of IPSP should concentrate in the next three years (Figure 8). The areas or projects introduced in FPP were *Local Network, Library Development, Computer Classroom* and *Technical Support.* [1]

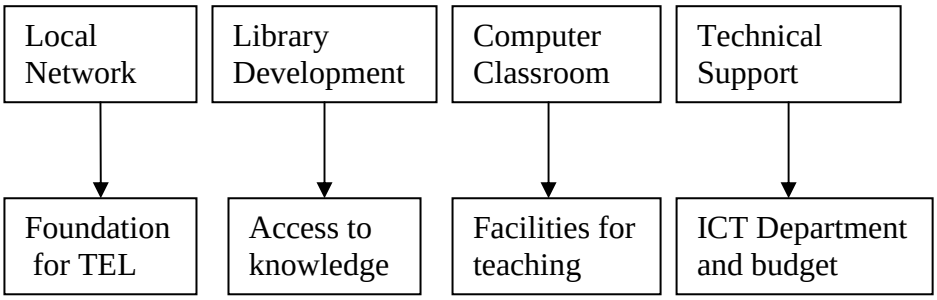

Figure 8: Key areas of FPP, leading to implementation goals of IPSP.

The purposes of the areas in FPP are summarized in Table 5. “Local Network” was aimed to build local area network on the campus, connect all computers to it and train students and staff to use it. Its goal was to create a solid foundation for all activities planned in phase Technology Enhanced Learning of IPSP. “Library Development” was aimed to solve two known problems in the library. The first one was to prevent or at least reduce books disappearing from the library by computerizing the cataloguing process. The other aim was to acquire new material for the library via CD-ROM technology, and an access to the internet. “Computer Classroom” was aimed simply to modernize the ICT laboratory for teaching. “Technical Support” was aimed to recruit new personnel to maintain computers and instruct introductory computer courses. [1]

Table 5: The purposes of the areas of FPP.

Local Network	**Library Development**	**Computer Classroom**	**Technical Support**
- Build Local Area Network - Train Staff and students	- Prevent books disappearing - Acquire new material	- Modernize ICT laboratory	- Recruit personnel to maintain computers - Recruit personnel to instruct computer courses

Finally FPP listed recommendations and comments for IUCO's administration to plan its ICT development (Figure 9). These recommendations and comments are important, because their aim was to guide IUCO's ICT investments during the years 2001-2004. The FPP´s recommendations' aim was to serve the short term objectives and comments' aim was to serve as long term objectives. [1]

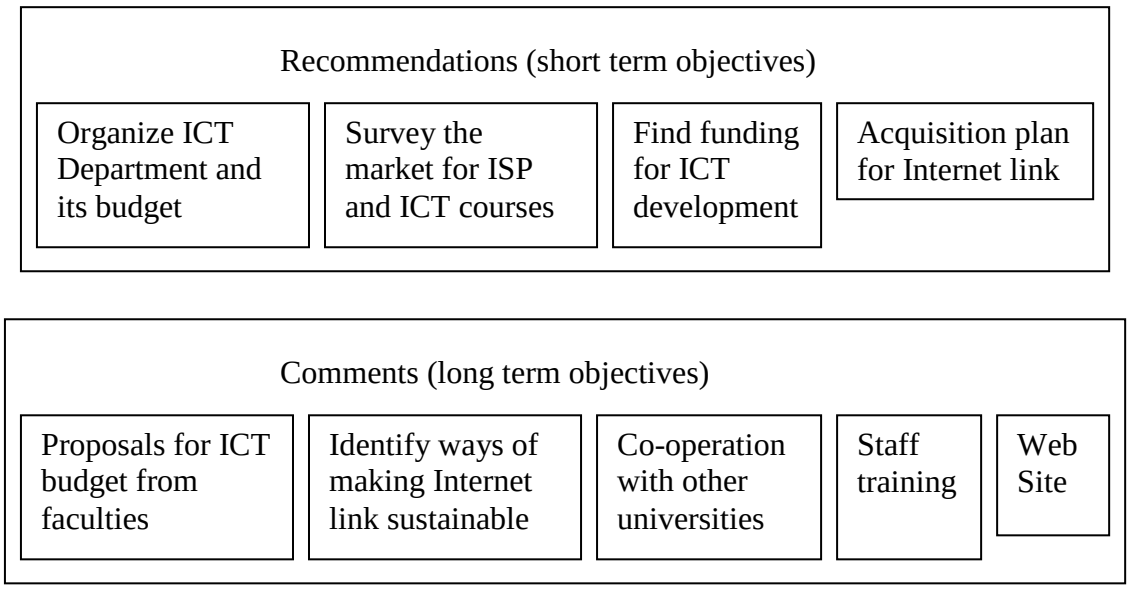

Figure 9: FPP´s Recommendations and Comments.

4.4.2. Impact on the implementation process

Six months after IPSP was published, Mr. Ashford worked out the FPP in order to clarify the short term commitments and set the priorities of the IPSP. Because of the known weaknesses in IPSP, he visited other East African universities (University of Nairobi, Sokoine University of Agriculture in Morogoro, and University of Dar es Salaam) and then discussed with the project organizing committee during the writing process. The committee had four members in March 2000: Prof. Nicolas Bangu (Head of the college, provost), Mr. Damian Gabagambi (Lecturer in Business and Economics), Mr. Jyri Kemppainen (Assistant Lecturer in Computer Science) and Mr. Richard Ashford (Research Associate, the head of the committee). [1]

Even if IPSP gave a vision for IUCO's administration to develop its use of ICT in education and FPP gave some more concrete steps to meet the vision, it was notified that they still were not enough for applying the funding for implementation. FPP stated that IUCO would apply funding for its implementation through FELM and its Finnish government funded program for development co-operation. This decision guided the development of the implementation plans so that they were designed specifically to fit in Finnish government development policy. [5]

4.5. Summary

This chapter has covered the design processes of IPSP (Figure 10) and partly answered to the first research question: What were the design and implementation processes of IPSP? The design process had two phases: the design of IPSP and FPP. The aim of IPSP was to create a stronger learning environment for IUCO through the use of ICT. The plan introduced several ideas of how IUCO should use ICT in its education, but they were difficult to implement in practice. The reason was that it only summarized the ICT facilities without analysis about their use and recommendations about the needed facilities except the internet connection. This weakness of IPSP led to the creation of FPP.

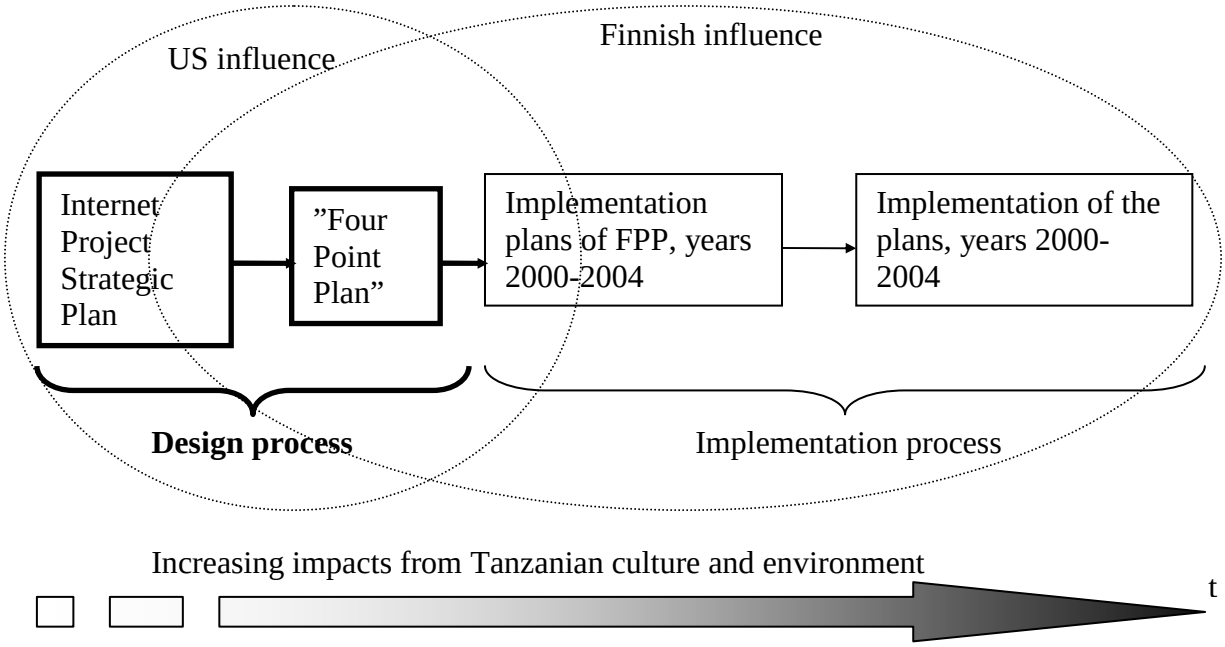

Figure 10: Design process of IPSP.

The ideas introduced in FPP were more concrete than IPSP from the technical point of view. It gave concrete steps to meet the aim of IPSP – a stronger learning environment via the use of ICT. Its background study was clearly wider, because it was based on the analysis of the ICT situation in some East African universities and all committee members were notified during the designing period. The decision of FPP to apply funding for implementation process through FELM and its Finnish government funded program for development co-operation led the development of the implementation plans. They were designed to fit in Finnish government development policy. The implementation process is described precisely in the next chapter.

5. Implementation process of the project

FPP was divided to four separate sub-projects for its implementation (Figure 11). They were created and separated because of administrative matters. ICT Department and its budget were clearly seen as an internal matter of IUCO and for internet connection there was not any financially acceptable solution available during that time [5]. The funding was applied from Finnish government for two of the sub-projects: Library Facilities Improvement Project and ICT Facilities Improvement Project[2]. The analysis of the latter (Chapter 5.1) is divided to several parts due to its extend compared to other sub-projects. [21, 24]

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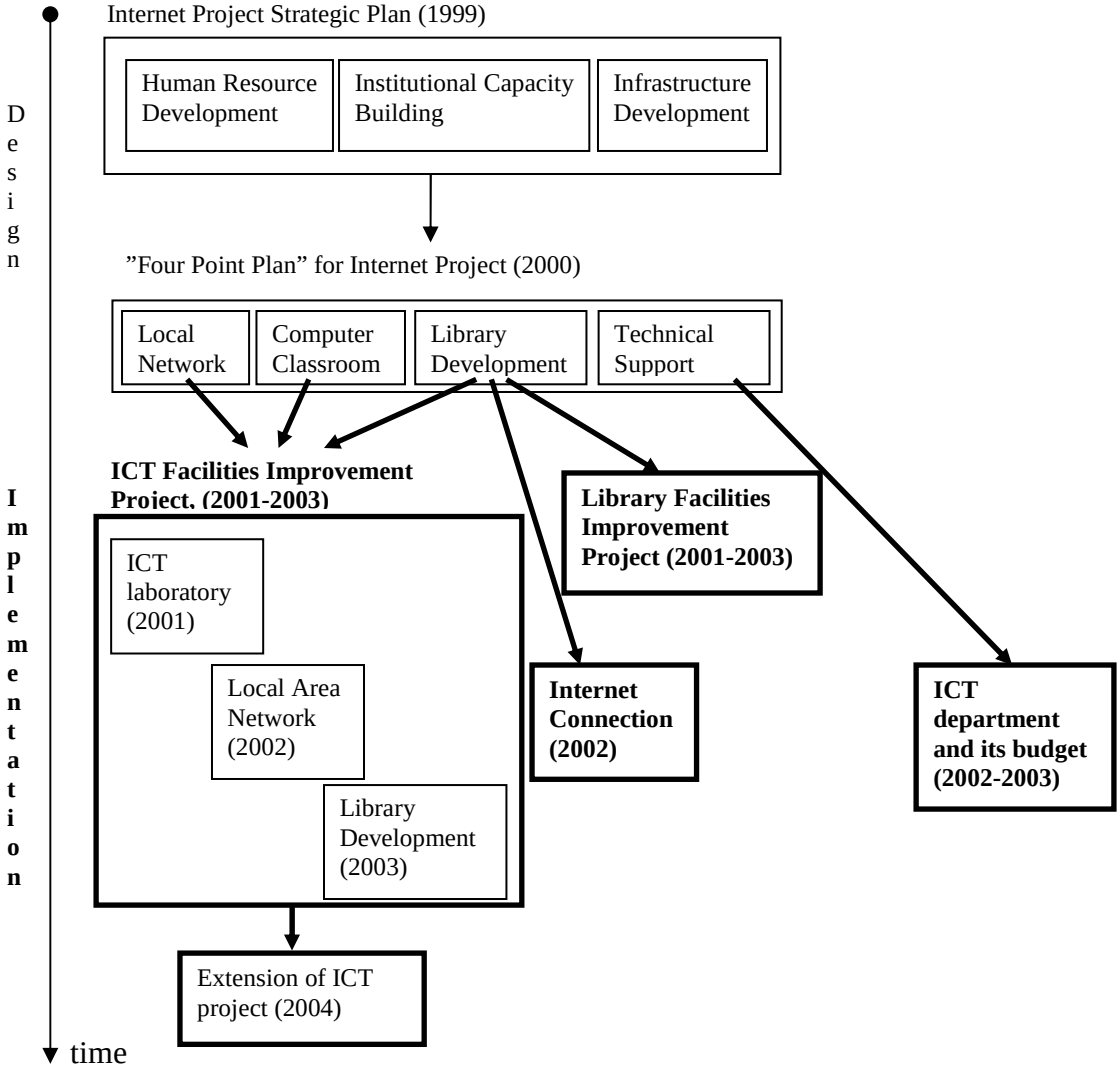

Figure 11: Implementation plans of FPP.

[2] The name ICT Facilities Improvement Project is used in this research instead of the original name Internet Project Strategic Plan project due to the collision with the name of the main project plan.

Library Facilities Improvement Project became the first one for which IUCO created the implementation plan in year 2000. Its implementation was urgent due to the fact that the most of the books available in the library (approximately 50 000 volumes) were outdated second hand copies [24]. However, the implementation of this project is not under the more precise study of this research paper, since it had no connection to ICT until the end of 2004. Still it needs to be introduced here because it was an important part of IPSP's implementation.

5.1. ICT Facilities Improvement Project

5.1.1. Preparatory steps

Because of my technical education and position in the project's organization (Chapter 4.4.2), I was responsible for the implementation and planning of *ICT Facilities Improvement Project* (IFIP). This second sub-project of FPP was still large and it was divided to three independent technical sub-projects (Figure 12). Their implementation order was chosen because of the investments' expected lifetime, for example LAN wiring was expected to be usable for a longer period of time than new computers. [21]

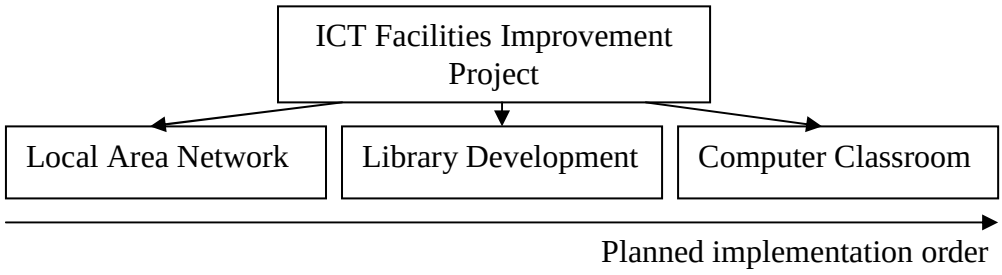

Figure 12: The sub-projects of IFIP.

The plans needed for implementation were made: budget for whole IFIP, sockets' and cabinets' location (Annex B: Figure B.1, B.2 and B.3) and topology for LAN wiring (Annex C: Figure C1, C.2 and C.3) [8, 11, 22]. Especially the plan for wiring was difficult to finalize, because of the lack of floor plans for the buildings. The pictures of buildings had to be drawn before it was possible to estimate the amount of needed cable [5, 40].

The final implementation order was changed, because of the approval of the project arrived late in November 2001. It was decided to implement ICT laboratory for teaching first, then LAN wiring and the activities in the library were left last (Figure 13). [23]

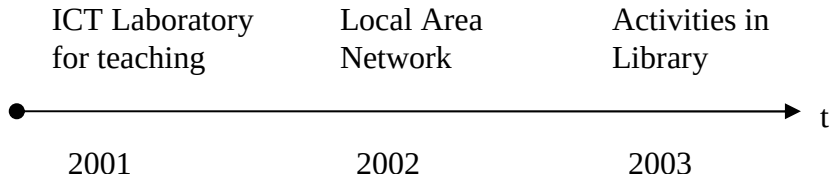

Figure 13: New implementation order.

When the project papers were sent to Finland they still had one unsolved problem: the price of the Library DBMS software. The budgeted price for Library DBMS was only a good guess, because no bidding invitation was received for it. The price was based on the discussions with some experts in Finland, USA and Tanzania. [5, 6]

Approval of the project in FELM reflects a shift in its organization and strategy. FELM was reluctant to approve it first, due to three main reasons. The first problem was the lack of funds available for new projects until 2003 due to the Finnish government fund frame for FELM. The second one was unwritten policy in FELM not to approve any Finnish government funded projects initiated by an employee of a first working term as I was. As far as I understood, the reason for this policy was the suspicion that projects initiated by newly arrived employees would fail more likely than others. The third problem arouse, when I got unofficial information about FELM's reluctance to engage itself in funding or supporting ICT facilities in developing countries. It was feared in FELM that the main donors would not see this kind of enterprise as a "proper mission work". Due to the above mentioned difficulties, the project was not accepted in the year 2001 budget of FELM. [6]

However, the project was quite unexpectedly approved in November 2001. There had been a transition period in FELM organization during the end of year 2000 and the beginning of 2001, which had delayed the general decision making processes. Also the general attitude towards ICT-projects had turned positive during this process and when the administration became functional again, the project was approved. Another reason for quick approval was

that Finnish government had decided to increase its annual development support for NGO´s in its budget as soon as 2001. [6]

5.1.2. Analysis of the role of the expatriate

During these preparatory steps my central role as implementer was found to be problematic from the Finnish government point of view, because it could have given the impression that IUCO was lacking commitment to the whole project. This led to a new project organization where the project organizing committee was headed by IUCO's Provost Nicholas Bangu and other members were Bursar Dr. Richard Hensey, Deputy Bursar Ms. Lilian Badi, Personnel Administrative Officer Mr. O. Mwaijonga and I. This new arrangement was done for the Finnish government officers and it did not have any effect to the implementation in practice. [21]

Before the implementation of IFIP started at the end of 2001, a dedicated bank account was opened for it. There were some special reasons for this arrangement: this was the first Finnish government funded project under my responsibility and I wanted to ensure on my best level that the funds would be used in a proper way. The authorized signatories were separated into two categories: two authorized persons were from the financial department and two others were FELM workers in IUCO. Also it was thought that the preparation of financial report would be easier, when a separate bank account is used. [22]

In this stage of the project, my role was inconsistent. On the one hand, my role as a project initiator had to be concealed, because from the Finnish government viewpoint I was not seen as an IUCO's employee, but only as a representative of an NGO. From IUCO's and my own perspective, I was college's employee who was put in charge of the project and also in control of funds. [5]

5.1.3. ICT laboratory for teaching

The items for ICT laboratory was defined in the project's budget (Table 6) and the first activity required for its implementation was the bidding invitations of the items. The proforma

invoices[3] were requested from the companies several times during the December 2001 and in the beginning of January 2002 [22]. The bidding negotiations were successful, because the price was reduced by 10% and the hardware level of the computers changed from Pentium III to Pentium IV. The ordered items were delivered in March 2002 and they were installed by a seller's technician [6].

Table 6: Planned Investment and procurement for ICT laboratory (US dollars).

Investments	Number and quality of units	Unit Cost	Freight, etc.	Total costs
Computer laboratory				
Equipment, machinery, and materials:				
Server computer	1	1 650		1 650
Server software with 21 licenses	1	728		728
Workstation	21	1 160		24 360
Monitors	22	335		7 370
Microsoft Office XP Fullpack for educational institutions	1	118		118
Microsoft Office XP 21 Licenses	21	25		525
Uninterruptible power supply for server	1	130		130
Laser printer	1	450		450
LAN Hub; 10/100 x 24 ports	1	680		680
Surge protector	13	60		780
Total costs			300	**$37 091**

5.1.4. Effects of the local business practices

I started the bidding invitations personally, but soon they were transferred to the finance department of IUCO. This meant that the role of IUCO's administration grew in the project implementation. The negotiations were time consuming not because of the bidding negotiations only, but in the beginning of the negotiations the proforma invoices were very erroneous. For example the needed software licenses or freight to Iringa were not included in them at all. Also UPS units were ordered instead of surge protectors during the negotiations, because of the many power cuts experienced on campus at the end of 2001. [5]

5.1.5. Local area network

Before FELM accepted the IFIP in its Finnish government frame, LAN wiring was already started with some donated LAN items. ICT problems of IUCO were introduced to some

[3] Term *proforma invoice* indicates an invoice sent in advance of the goods offered and it is widely used in Tanzania during the bidding invitations.

visitors from Minnesota as early as at the beginning of 2000 and they donated some material for this purpose. The LAN wiring for the first ten offices was done before the implementation of IFIP started in December 2001 (Figure 14). [6]

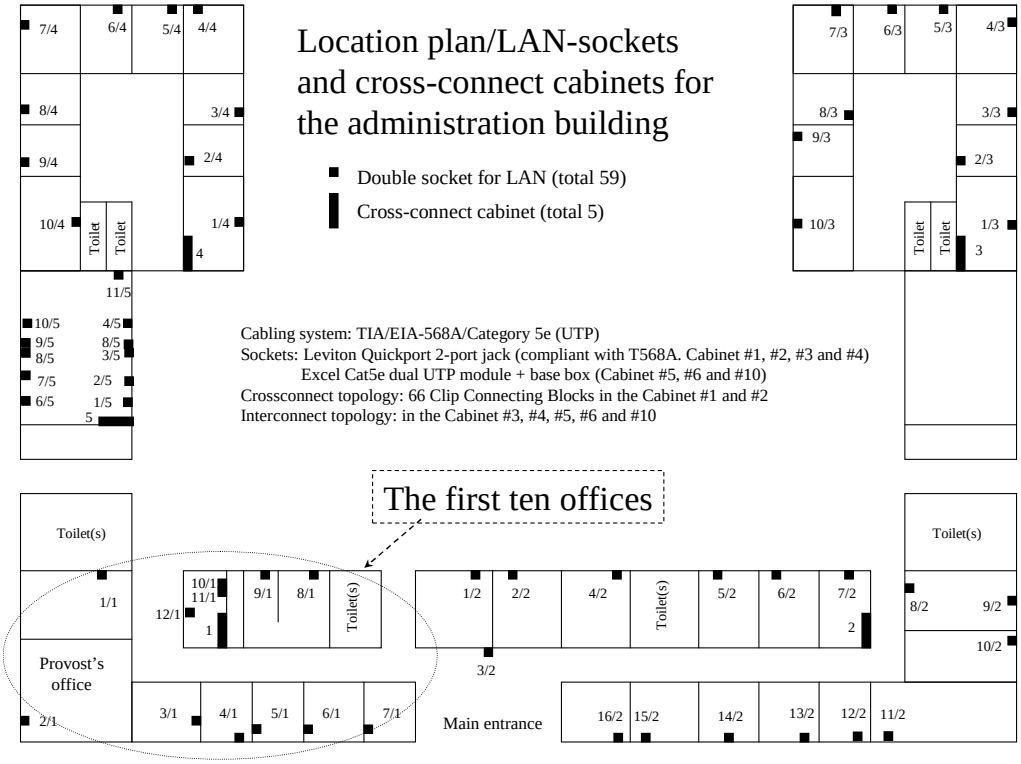

Figure 14: LAN wiring in Administration building.

The bidding invitations for ordering the LAN items (Table 7) started in September 2002 and continued for three months time [22]. There were two reasons for the long negotiation period: the connection between the buildings and the wiring work. The solution for connecting buildings that was introduced in the original topology, fiber optic cable, was found to be too expensive at that time. It was obvious that it was difficult for ICT companies to offer the option at all. Also it was found that the most commonly used method connecting LAN between buildings in Tanzania was indoor twisted pair cable [22]. It was decided to use wireless link instead of twisted pair, because IUCO had had some difficulties with the buildings' electricity wiring and it was not reasonable to connect the buildings together electrically via LAN [23]. Also the companies did not want to write down the price for the whole wiring work in advance and the daily price was given only without any estimation of the total amount of working hours. Those offers were not acceptable; therefore it was decided to do the work without outside help [5].

The wiring work continued during the bidding invitations with the donated materials in the administration building as described in Figure 15. It followed the order given by location plan (Figure 13), the area of cabinet #1 first then cabinet #2, #3 etc. [40]

Table 7: Planned investment and procurement for LAN (US Dollars).

Investments	Number and quality of units	Unit Cost	Freight, etc.	Total costs
Administration building				
Equipment, machinery, and materials:				
IT Control Center…				
Server computer with software	1	3 000		3 000
Double sockets, cables and installation for LAN	2	250		500
LAN switch; 10/100 x 24 ports	1	680		680
Wireless LAN access point	1	400		400
Unterrupted power supply for server	1	130		130
Cabinet for LAN switches	1	150		150
Surge protector for switch	1	60		60
Total				**4 920**
IT Service Center…				
Double sockets, cables and installation for LAN	2	250		500
LAN switch; 10/100 x 24 ports	1	680		680
Cabinet for LAN switches	1	150		150
Surge protector	1	60		60
				1 390
PC for print server/communications/etc.	2	2 300		4 600
Laser printer	2	450		900
Inkjet color printer	1	400		400
Surge protector	3	60		180
				6 080
LAN for administration building				
Double sockets, cables and installation for LAN	40	250		10 000
Wireless LAN access point	1	400		400
				10 400
Library				
IT Service Center in Library…				
Double sockets, cables and installation for LAN	2	250		500
LAN switch; 10/100 x 24 ports	1	680		680
Wireless LAN access point	2	400		800
Cabinet for LAN switches	1	150		150
Surge protector	1	60		60
				2 190
LAN for library				
Double sockets, cables and installation for LAN	10	250		2 500
Wireless LAN access point	1	400		400
				2 900
Total Equipment, machinery and materials			600	**28 480**
Construction activities:				
IT Control Center				
Enhanced physical security.	1	1 200		1 200
Other physical modifications to suit operations.	1	950		950
Enhanced wiring (electric)	1	250		250
IT Service Center				
Enhanced physical security.	1	1 200		1 200
Other physical modifications to suit operations.	1	950		950
Enhanced wiring (electric)	1	250		250
Total construction costs				**4 800**
Investments Grant Total				**$33 280**

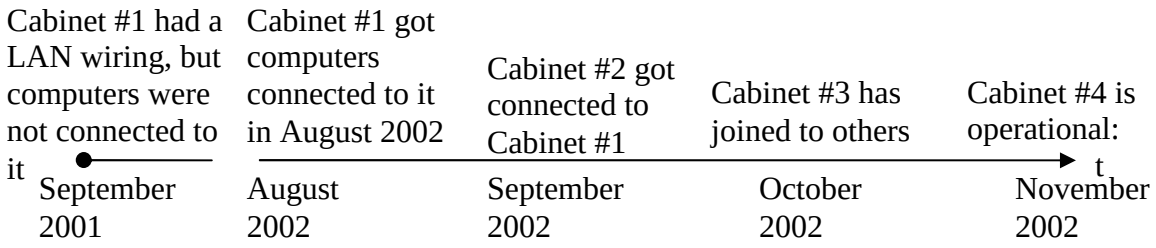

Figure 15: Time chart for wiring work inside the administration building in 2001 – 2002.

After the arrival of the ordered LAN items, the wiring work continued in the library as described in Figure 16 [23].

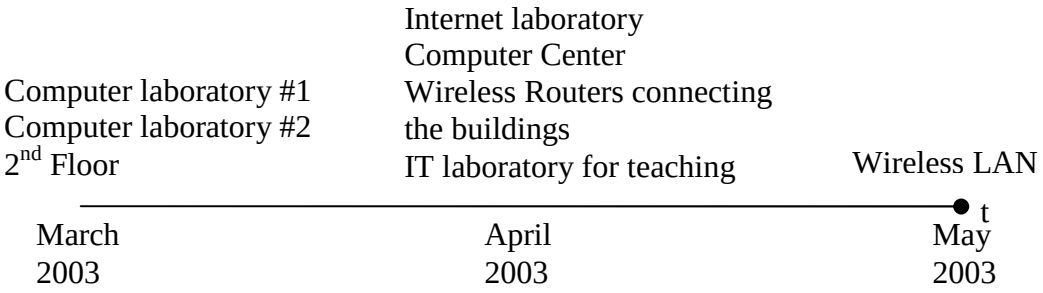

Figure 16: Time chart for finalizing wiring work in year 2003.

When the wiring was operational in the library, the topology plan was implemented (Appendix C: Figures C.1 and C.2) in both buildings. [23].

The cabinets for LAN switches and other central LAN items were constructed from wood by local carpenters. The price for commercial LAN cabinets was checked first and it was found to be extremely high, so the pictures for cabinets were drawn and a local carpenter constructed a test version as early as August 2001 [15]. The test cabinet was installed in the administration building during the LAN wiring there (Cabinet #1). The rest of cabinets were constructed for the project in years 2002-2003 [22].

There were two separate breaks during the wiring work (Figure 15 and 16). The reason for the first break was that my working period in IUCO ended in March 2002, just after the year 2001 sub-project had been finalized [9]. The wiring project had not continued until I returned back to Iringa in the beginning of September. The reason for the second break was simply the lack of items. After finalizing cabinet #4, practically all the donated materials were used and the

difficulties during the bidding invitations delayed the arrival of the needed material for about three months time [5].

While the wiring work was in the process, IUCO started the bidding negotiations for purchasing the server computers for controlling users' access and providing various LAN services. The funds for purchasing them were also included in the year 2002 project's budget (Table 7, p. 36). [23]

Two server computers were installed in the computer center in the library and one in the ICT service center in the administration building. Windows 2000 Server operating systems were installed in all server computers and two of them were configured to act as AD domain controllers with DNS, DHCP and WINS services. One was located in the library's computer center and the other one in the ICT service center in the administration building. The second server in library was configured to act as dedicated file server. All the three servers were used for giving configurations to the workstations in the administration building only until the September 2003, when the LAN accounts for students were created. The configurations of workstations were changed in a way that it was impossible for students to use the computers without logging on with their personal username and password. [23]

5.1.6. Observations on the working environment

Experiences gained from building LAN had two main impacts on the continuation of the project: how the availability of technology affects the solutions, and how the existing working environment and lack of background information can hinder project style work. [5, 6, 23]

Technically best possible solution, fiber optic cable, had to be left out. Its price was far beyond the budget frame, but even if there had been resources to purchase it, it would not have been a sustainable solution. Question remained, whether there had been enough know-how to maintain it locally without foreign expertise. [5, 6, 23]

Also the fact that local ICT-companies refused to estimate the expenses of the whole wiring work in advance made the budgeting and future plans of this kind of project work much more complicated. The reason for this was, that there were not exact floor plans drawn by

constructor available, nor was there enough technical information available about the buildings such as existence of cable chutes. [5, 6, 23]

Additional observation for future decision making was made, when it was noticed that some needed items can be produced locally instead of importing them. This happened in the case of cabinets for LAN switches. [5, 6, 23]

5.1.7. The library development

The most important construction activities connected to the project were organized in the library at the end of 2002: two new computer laboratories, Computer Center, ICT maintenance room and ICT Service Center were designed to be built in the library (Figure 17). [7]

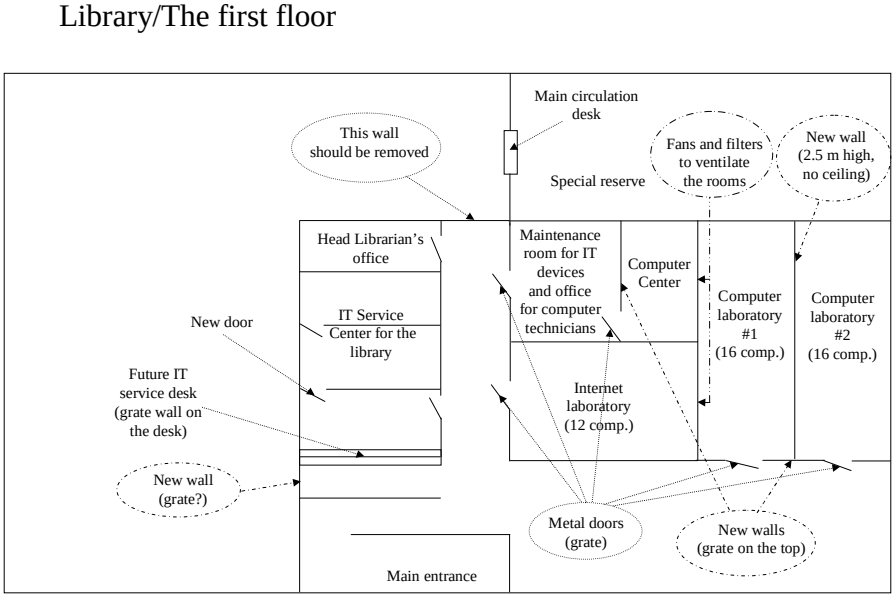

Figure 17: The library rooms' re-allocation in the first floor.

The physical security was improved in all ICT rooms by grilling the doors and windows, and limiting the access to the room keys to ICT personnel and the responsible administration personnel only [24]. Fans and filters (Figure 17) were installed in the rooms first, but they were found to be too poor for ventilation during the hot season. They had to be replaced with air condition units [23].

The bidding invitations for purchasing the items for the internet laboratory started in June 2003 (Table 8). The project's budget had been prepared initially in US dollars, because all ICT items were priced in this currency in Tanzania. FELM headquarter personnel had converted the project budget to Finnish currency (FIM), because of the normal budgeting procedure in Finland. The rate difference between currencies increased the available funds for the project implementation in 2003. Because of the above mentioned reason the number of computers could be increased from eight to twelve during the negotiations. When the computers arrived their installation was done without any difficulties and the internet laboratory was operational before the students arrived for academic year 2003/2004 in September. [22]

Table 8: Planned investment and procurement for Library (US Dollars).

Investments	Number and quality of units	Unit Cost	Freight, etc.	Total costs
Library				
Equipment, machinery, and materials:				
IT Service Center in Library…				
Server computer with Linux	1	2 000		2 000
Unterruptible power supply for computer	1	130		130
Library management system (software)	1	7 000		7 000
Installation and modifications	1	9 000		9 000
				18 130
Laser printer	1	450		450
Dedicated fax/copier	1	450		450
Inkjet color printer	1	400		400
				1 300
Multimedialaboratory				
Multimedia/Internet stations	8	1 600		12 800
Surge protector	8	60		480
				13 280
Total Equipment, machinery and materials			600	**33 710**
Construction activities:				
IT Service Center in Library…				
Enhanced physical security.	1	1 200		1 200
Other physical modifications to suit operations.	1	950		950
Enhanced wiring (electric)	1	250		250
Total construction costs				**2 400**
Investments Grant Total				**36 110**

Besides the internet laboratory, another area of investment was the *Database Management System* (DBMS) for the library. The open source software had been under study in IUCO at the beginning of year 2002 [6], but the general attitude was that the university graduates would get employed better with knowledge of Microsoft software than the open source software. For example, it was common that the employers tested candidates´ knowledge about Microsoft Excel, not spreadsheets generally [23]. The question about the use of open source software became current again during the selection of the suitable library DBMS for IUCO's library in the end of year 2003 [23]. The library had started using Microsoft Access based

catalogue called PAKA as early as August 1998. Its only aim was to start entering information on the library's holdings. It was known that the entering process was time-consuming, it had to be done correctly and any searches performed on database would go unrewarded without a certain amount of information stored there [57].

The preliminary study for replacing PAKA with better library DBMS was done in FPP. It stated that library DBMS had to serve the IUCO's long term objectives and introduced there some of the used systems in Tanzania (Bookworm, Alice and CDS/ISIS). This information was the starting point when the information of available library DBMS options was updated in September 2003. The commercial options used in many western libraries were found to be too expensive, but there were some un-commercial software available also. This part of the IFIP was difficult for IUCO to implement at all, because of lacking an educated librarian in the library. This background analysis led me to ask help from Mr. Finne, Managing Director of 4C Center in Finland. [6]

The separate plan for implementing the library DBMS was made. It included the schedule, definitions, workflows and reporting for the implementation of the library DBMS (Figure 18). [3]

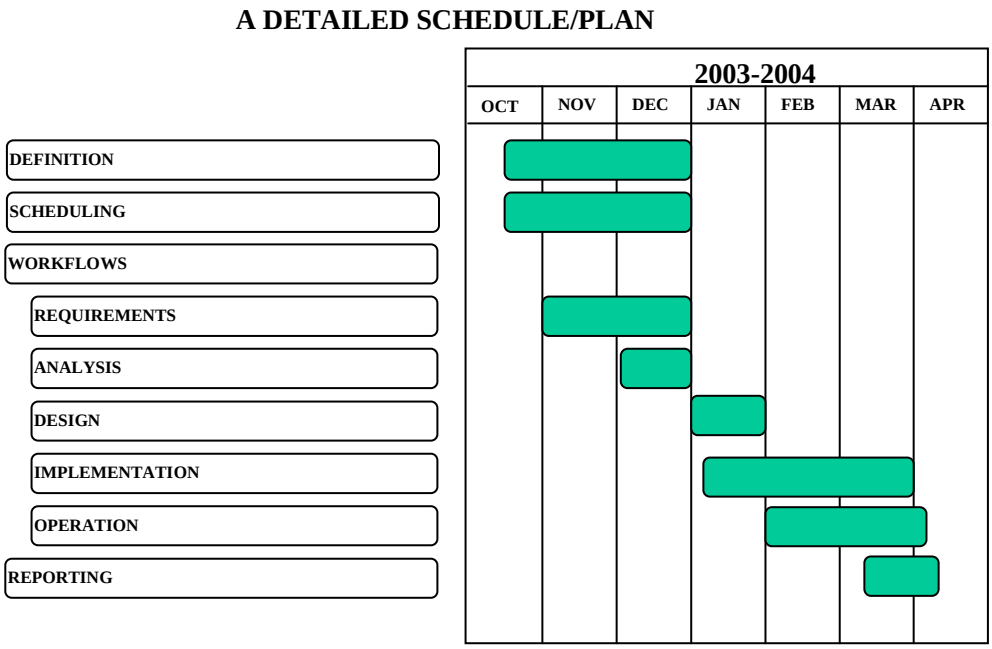

Figure 18: Time schedule for implementing DBMS of the Library.

It was emphasized in the plan that the DBMS had to be based on the open source software platform and the commercial software could be used only if the implementation failed with this path. Also it was stated that WWW-browsers should be the only user interface needed for using the database. [3]

The available software options were explored and two of them were recommended for a deeper analysis before the decision. The recommended software was CDS/ISIS from UNESCO and Koha, because they both were based on the defined platform. After a short investigation, it was decided to continue with Koha because it fulfilled the specifications defined in the plan better than CDS/ISIS. Koha was published on the internet under the GNU General Public License and its source code was downloadable for the modification [43]. Also the preliminary research showed that it would be easier to get support from Koha developers than CDS/ISIS during the implementation [6].

Koha was developed in the Linux environment using de-facto standard software tools available there and its environment was specified first (Figure 19) [43]. MySQL and Apache were chosen to be the database and www-server, because they were selected by the developer team of Koha for the original installation. Also they were found to be the most commonly used with Koha [6].

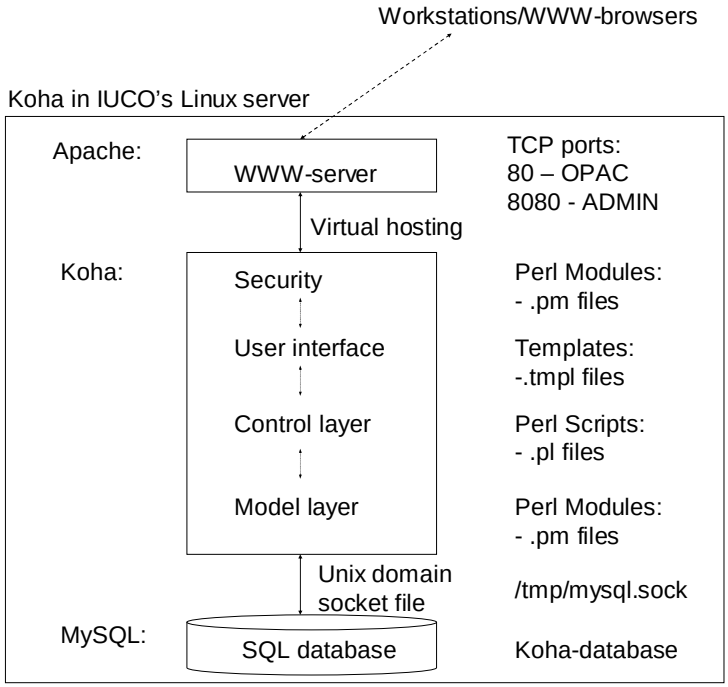

Figure 19: Architecture of Koha.

Koha was eventually installed and operational in May 2004. However it was noticed during the tests that the installed revision of Koha had some software bugs in it. Those bugs were found to be critical and they had to be fixed before the server was moved to its final location in the library. [6]

5.1.8. Further observations on the working environment

The role of the physical environment (security, temperature etc) for the library development was larger than it was anticipated. Their impact was not taken into account in the planning phase, and the needed adjustments were made while the project proceeded. [5, 22, 40]

Fluctuations in exchange rates had remarkable positive impact on the resources, when instead of eight workstations, twelve were obtained. It was noticed, that the situation could have been quite opposite in case the rates had changed otherwise. [23, 40]

Open source software proved to be a realistic option only for server computers. It would not have qualified for the only software to be taught to students; it should at least have been complemented with commercial software as well. This was because the local employers preferred students to be skilled rather with commercial than open source software. Even the fact that open source software was free of charge, had not increased its use since illegal copies of commercial software were openly available. [5, 23]

5.2. ICT department and its budget

5.2.1. Guaranteeing the long-term functionality

The third area of FPP, Technical Support, was not financially connected to the Finnish government funded project (IFIP), but still it was an extremely important part of it. Sustainability defined by the Finnish government is “long-term functionality of developed systems. Sustainability consist of sufficient economic and financial basis for long term operation and maintenance, institutional capacity and capacity to manage the systems, good

socio-cultural feasibility, reliable technical operation and maintenance and acceptable environmental impacts" [53]. Finding a way how to guarantee sustainability of IFIP has been the key question during the implementation of the project since the beginning [23].

FPP pointed out two core barriers on the way towards a long-term functionality: IUCO was not allocating any funds for its ICT development and it did not have an organized ICT department. [1]

The funding problem was solved by a decision to introduce a fee called Student Computer Access Fee starting in the academic year 2002-2003. Even though the allocated money was not enough for covering all ICT costs like investments, it was seen as significant improvement to the previous situation. [23]

The task to organize ICT department in IUCO was a challenge, because of the lack of qualified Tanzanian ICT professionals in Iringa [23]. The administration of the college had had discussions about the lack of the Tanzanian ICT professionals for quite a many years and the situation improved, but it was happening too slowly. IT Service Center had been designed for providing printing, fax, and email services for staff in the beginning of the year 2002. This center was found to be successful and similar service center was opened in the library for providing printing services for students in the beginning of year 2003. Later same year, the services were expanded to copying service for staff. These centers improved the services they were aimed at, but they had not effect on the situation in ICT teaching, development, maintenance or support [4].

The idea of educating Tanzanians in Finland on ICT field was introduced to IUCO's ICT personnel as early as 1998. A visitor, who stayed for some weeks in Tanzania 1998, facilitated a position for a Tanzanian student to study computer engineering in the Espoo-Vantaa Institute of Technology. Later the plan of educating IUCO's graduated students in Finland on ICT field was created and the positions and scholarships were organized for two IUCO's former business students to study computer science at the University of Joensuu. [6]

The college's administration made some effort to recruit qualified ICT professionals during the year 2002, but the candidates´ lack of formal ICT education delayed the process of establishing ICT department's organization until 2003. Even though there was not official

organization established, the first Tanzanian ICT teacher was hired for university in hourly basis and a former secretary, who had acquired one year ICT education, started working for ICT during the academic year 2002-2003. Finally the need to organize ICT department also officially became urgent in the beginning of 2003, because the last volunteer-based ICT teacher left the college and there were no-one to replace him. [23]

A proposal for ICT department's organization in year 2003 included positions for four Tanzanians and one foreigner: the Head of the Department, IT Instructor, Computer Technician, Help Desk Person and IT Advisor (Figure 20). The proposal defined also the responsibilities for the positions and recommended certain candidates for them. This organization was planned for less than 600 students, but its structure was supposed to be flexible. It would be easy to add more positions for ICT instructors, Computer Technicians, Help Desk Persons and Advisors in the case they were needed. The proposed organization was fully implemented by the end of 2004 with one exception: the computer technician's position was filled by another person. [12]

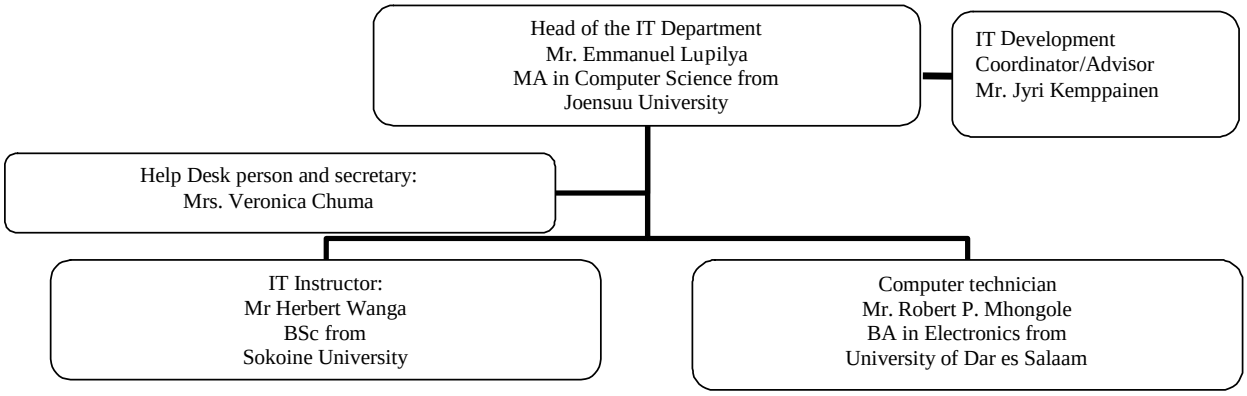

Figure 20: Proposal for IT Department organization.

5.2.2. Changes in the staff policy

It was noticed that the recruitment of personnel has to be based on long-term strategy. In Tanzania it was extremely difficult to hire staff who would be both formally qualified and practically experienced, and who would also be committed to work for IUCO's development. The best option to solve the problem was to educate the employees already from the students´ level or by further educating the already existing staff. This long-term process of providing

future ICT professionals with suitable education, required assistance from such co-operation partners who were not bound to short-term results only, but could set their co-operation goals several years ahead. The long-term commitment was important also when sending expatriates to serve the co-operation partners: as valuable as short-term volunteers were for specific projects, more long-lasting effects and more sustainable development were gained when an expatriate with special expertise committed to several years´ services. [5, 6, 23]

5.3. Internet connection

5.3.1. Process of getting connected

The fourth area of FPP, Internet Connection, was the most important part in whole IPSP. This aim was stated clearly in its vision and goal (Chapter 4.3.1). Planners of IPSP believed that IUCO would get the internet link in coming four months after making the plan public, and the whole campus would have the connection in next three years' time. IPSP introduced two steps to be taken on the way to optimal campus wide Internet connection (Figure 7, p. 24). The first step included one option and the second step two different options (Figure 21, 22 and 23). The selection between the options in the second step depended on the amount of funds available. [2]

These steps were originally a result of misunderstanding between me and Mr. Ashford. When these pictures were drawn, the aim was only to give three different options for hardware needed with the internet connection and the selection between them would depend on the donors and available funding. Mr. Ashford from his part thought that all the above mentioned three options are three different steps that all have to be taken. [5, 10]

IUCO investigated the options for internet link during the years 1999 and 2000, but there were not any serious negotiations until the year 2001 [1]. The reason for the delay was monthly costs of the internet links available in Iringa. They were found to be much too high for IUCO to afford [22].

The basic hardware for the Internet connection

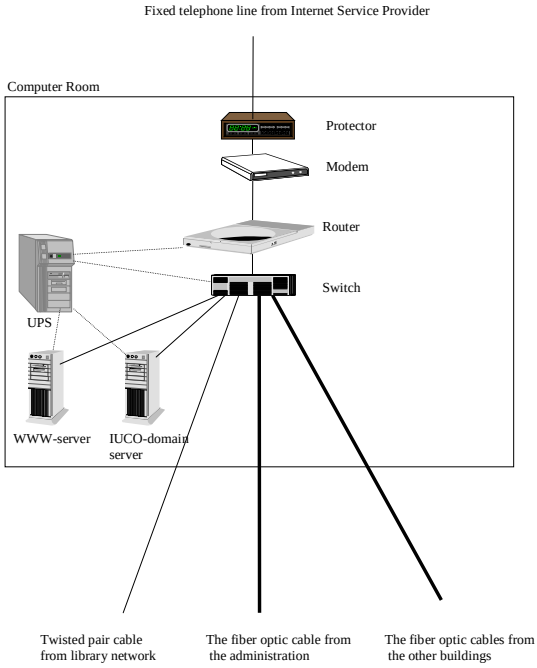

Figure 21: Step one of IPSP – Internet Link to Dar es Salaam Service Provider.

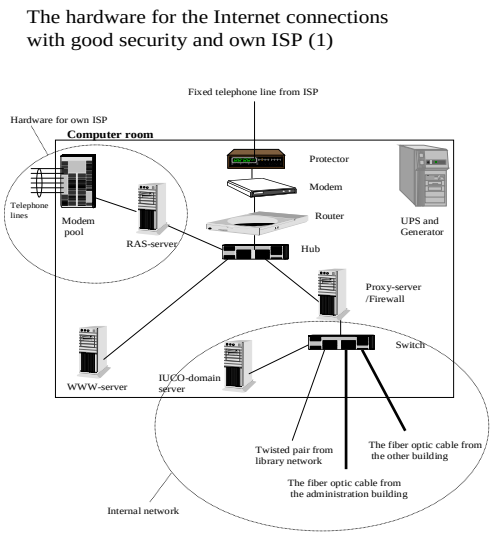

Figure 22: Step two of IPSP/Minimal option – Landline Internet Link and Creation of Own Service Provider.

The hardware for the Internet connections

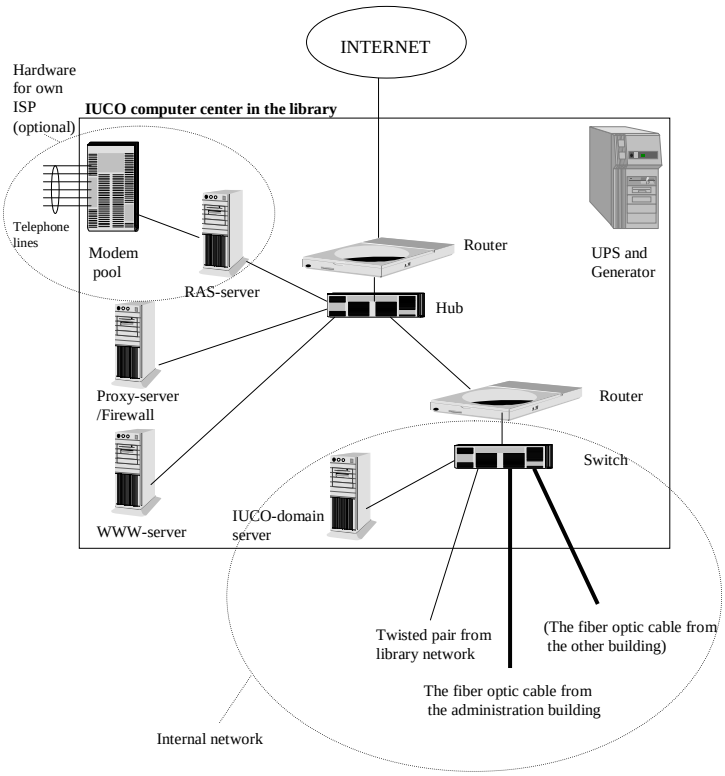

Figure 23: Step two of IPSP/Optimal option – Satellite Internet Link and Creation of Own Service Provider.

Because of the planned satellite connection to the internet (Figure 23), IUCO applied for the permission from Tanzanian Communications Commission (TCC) to act like a closed user group internet access service provider. The license was granted by TCC in January 2002, but it was not needed until the end of year 2004. [19, 23]

The first serious negotiations for getting internet link to the campus started with some satellite companies at the beginning of 2001. After the first proforma invoices, the negotiations continued with a provider called SimbaNET. The negotiations failed at the end of February 2002, because of the two main reasons: firstly SimbaNET could not propose any kind of service level agreement and secondly the total costs of the three years agreement were too high, nearly 60 000 US dollars, for IUCO's annual budget. [6, 18]

There were many difficulties during the negotiations with satellite service providers, for example IUCO' premises were found to be poor for needed hardware during the SimbaNET engineer's site survey [17]. It was noted that the electricity grounding was not good enough for VSAT[4] equipment, no air conditioned and dust free room was available for them, and a safe location should be reserved for a 600 kg outdoor unit before the installation was possible [59]. These difficulties speeded up the decision to accept the landline connection via Simunet's network [6].

Simunet Company Limited (the company owned by Tanzania Telecommunications Company Limited, TTCL) started offering internet connections via TTCL's landline network in Iringa during the IUCO's negotiation period with SimbaNET [18]. Their offer 128/64 Kbps shared link with the total costs 30000 US dollars/three years period was acceptable and the connection was installed in the campus in August 2002 [13]. Practically the whole campus had connection at the beginning of 2003 [23].

5.3.2. Faced difficulties

Communication between people from different countries and cultural backgrounds needs to be paid attention to. Both Mr. Ashford and I were newly arrived in Tanzania and could not avoid unintended misunderstanding which resulted either from insufficient language skills or different kind of communication cultures. [5, 6]

It was learned that project plans should be flexible. Also in a developing country, technological changes are rapid and a solution that seems to be impossible to use today, can be available already tomorrow. However, the technical level of current buildings can prevent the use of new technology even if the buildings are not old as such. [5, 6, 22]

[4] VSAT, Very Small Aperture Terminal, an earthbound station used in satellite communications of data, voice and video signals, excluding broadcast television. VSAT consists of two parts: a transceiver which is placed outdoors in direct line of sight to the satellite and a device which is placed indoors to interface the transceiver with the end user's communication device.

5.4. Extension of IFIP

5.4.1. Extension of LAN

The implementation of IFIP (Chapter 5.1) concentrated on ICT facilities of two buildings only (administration building and library). It left a laboratory for Department of Journalism untouched due to its location in the third building. The laboratory was important since it was used for publishing a newspaper called Tumaini Hill and Tumaini Weekly - newsletter. [21]

The head of the department wrote a letter to IUCO's administration after a consultation with ICT personnel [16]. In the letter the needed equipment was identified for the laboratory. This idea was introduced to FELM headquarters as one year extension of the IFIP in November 2002 [20]. The implementation plan with the budget was made in June 2003 (Table 9) and the extension was approved without any difficulties [6].

Table 9: Planned investment and procurement for the extension.

A5: Investments and procurement

Investments	-N-	Source	Number and quality of units	Unit Cost	Freight, etc.	Total costs
Investments						
Equipment, machinery, and materials:						
Server computer with software			1	4 000		4 000
Workstations			5	1 300		6 500
Double sockets, cables and installation for LAN			8	250		2 000
LAN switch; 10/100 x 24 ports			1	350		350
Uninterrupted power supply for server			1	450		450
Uninterrupted power supply for workstations			5	150		750
Cabinet for LAN switch			1	50		50
Surge protector for switch			1	60		60
Laser printer			1	500		500
Scanner			1	300		300
Wireless Router			1	1 800		1 800
						16 760
Total Equipment, machinery and materials					600	**$17 360**
Investments Grant Total						**$17 360**
					EURO:	**15 782**
Construction activities:						
Mast for Wireless Router						250
Construction activities Grant total (year 2002)						**$250**
					EURO:	**227**
Investments Grant Total						**$17 610**
					EURO:	**16 009**

The implementation of extension started in February 2004 with bidding invitations for purchasing the budgeted items. The ordered workstations arrived in the beginning of June and they were all installed immediately in the laboratories (four to Tumaini Hill and one to media

-laboratory). The server computer arrived later and it was installed in Computer Center serving as WWW and email server in October 2004. [23]

The electricity gave difficulties to ICT items during the implementation of extension of IFIP. Due to the fact that the electricians available in Iringa could not find the reason(s) for those problems, IUCO tried and managed to organize a volunteer-based electrician from USA to work for it for one year, starting from July 2004. He was highly experienced in working for industry, thus capable of solving the problems. Later Tanzanian electrician was hired to work with the volunteer. The aim of this organization was to find a solution to the ongoing electricity problems and educate a local electrician in this area. Because of the difficulties and their connection to the sustainability of LAN wiring, it was decided that the wiring work of the extension should be done by electricians. The decision was based on the idea that the work would be excellent practice for them and during it the knowledge of the used methods would be transferred to a Tanzanian electrician. The LAN wiring in the laboratories were done during November-December 2004. [22, 23]

The problems given by the electricity changed the plan to use wireless network between the buildings. One of the wireless routers serving for the administration building was lost in August 2004; even it was very well protected by UPS unit and surge protector (Figure 24). It was found that the grounding was totally disconnected in many places in the buildings and the electricity cabling was not thick enough compared to the total amount of load there. [22, 23]

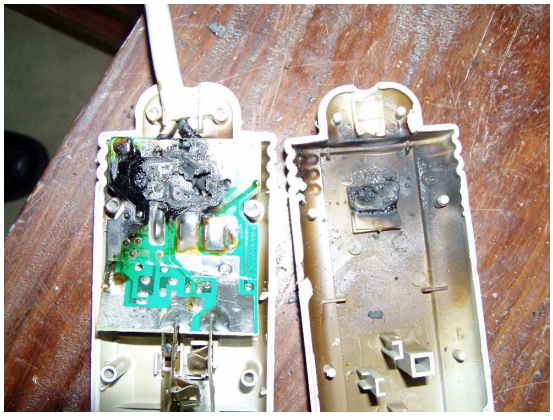

Figure 24: Surge protector that protected SPEEDLAN 9101 router after the hit.

The connection between the administration building and the library was changed temporarily to twisted pair cable when the router was lost. Later it was decided to cancel the delayed

delivery of the third wireless router and return back to original plan of IFIP and use fiber optic cable between the buildings. There were two reasons behind the decision: everything possible had been tried to protect the wireless routers against electricity shocks (UPS, surge protector, separate grounding for out-door unit) and still one was lost during the dry season. It was anticipated then that it would be impossible to keep them operational during the rain season, because of very likely flash hits. Also the decision was possible because of the changed situation – the price was now reasonable and the project budget had enough extra money for the implementation, and our own electricians could implement the needed wiring. [22, 23]

5.4.2. Reflection of the utilization of technology

When journalism students and teachers got access to the internet in the library and offices, they realized how useful tool it was for them. They made an initiative to expand the connection in the journalism laboratory, since they now wanted to be able to utilize the Internet better in their department. When the use of new technology became possible, it created new needs which had not been taken into account in the project earlier. Since the project was flexible, we could include the extension to the project. [16]

Complicated and widely spread electricity problems made it obvious, that additional expertise was needed. After several attempts it was realized that the problems could not be solved locally. Outside expert was invited, and since his know-how was rather unique, it was seen important that there would be an opportunity to pass his skills to a local electrician who was employed to work with him. In other words, the presence of an expert was utilized in best possible way, since previously it had happened that when a volunteer left IUCO, s/he had not trained anyone local properly. It was learned, that even the short-time volunteers should be seen and employed as educators and co-operation partners, not only as individual consultants. Therefore, their work should be organized from that perspective as was done with the American industrial electrician. [5, 6, 23]

5.5. Summary

This chapter has covered the implementation processes of IPSP (Figure 25) and completed answering the first research question: What were the design and implementation processes of

IPSP? FPP was divided to separate sub-projects for its implementation due to the administrative matters. The implementation of ICT department and its budget were seen as an internal matter of IUCO and there was not financially acceptable solutions available for internet connection during that time. The funding was applied from Finnish government for two of the sub-projects: Library Facilities Improvement Project and ICT Facilities Improvement Project. The analysis of Library Facilities improvement project was left out from this study because it had not connection to ICT during the research period.

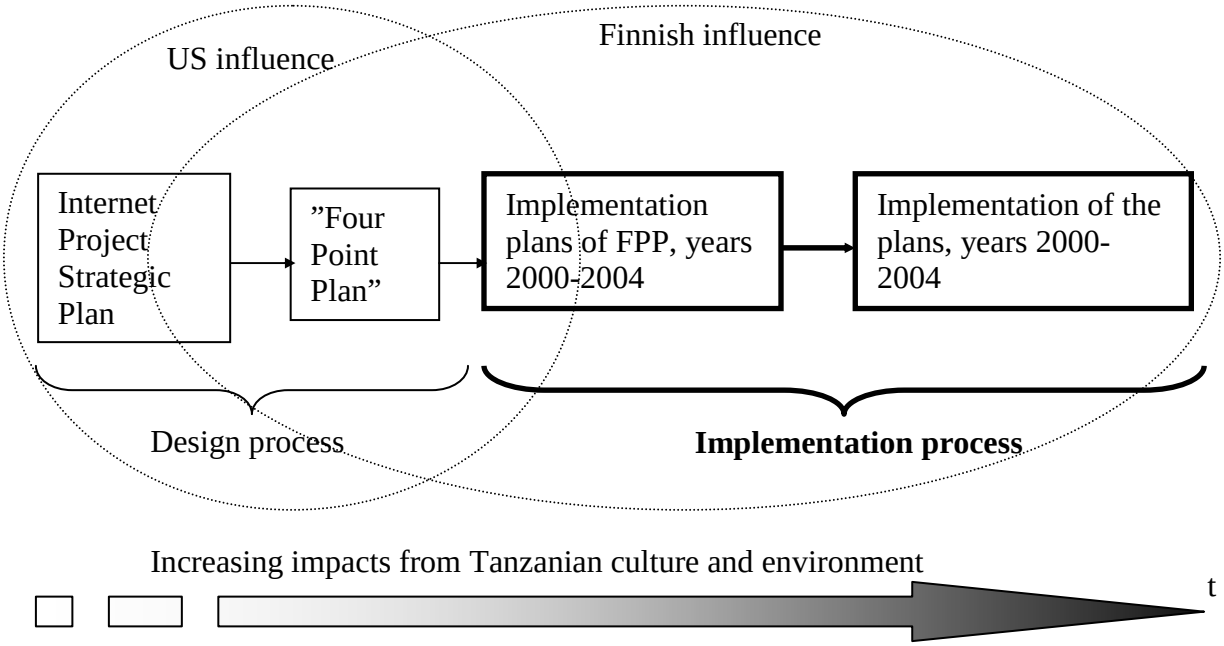

Figure 25: Design process of IPSP.

ICT Facilities Improvement project, its extension and the internet connection were the technical parts of the implementation of IPSP and they can be seen as the foundation of the whole implementation process. It was clear in the beginning of the implementation of FPP that without functional technical infrastructure at IUCO’s campus all other attempts to meet the aim of IPSP would have failed.

During the implementation process the different roles of foreign experts were learned. Their knowledge about locally available resources, current situation in the working environment and needs of the local culture increased during their individual cultural adaptation process (Chapter 2, p. 4). This adaptation process was also seen in the communication between the people from different backgrounds.

When short time expertise was used, it was important to coordinate their work carefully in advance. Their expertise was utilized in a sufficient way only when the local organization had realized the problems and its own limitations to solve them. This meant that the identification of the problem and its specifications were needed before inviting the foreign experts.

The role of the long term foreign expert changed during the processes. In the beginning he was seen as a short time expert as explained above. Then his role changed to be as a team member and finally it was developed to as the key implementer, when I was seen as a member of the local organization. This local development did not affect to the attitude of the foreign donor. I was seen as a consultant during the whole implementation process even my role was changed locally.

The sustainability of investments for ICT facilities demanded by Finnish government speeded up the process of organizing ICT department and its budget for maintaining the facilities. This process was complicated due to the lack of formally educated ICT personnel needed for a university in that region. Only functional solution was to educate employees from the students and existing staff. This kind of solution is always a long-term process and it required such co-operation partners, who were ready to set their goals to several years ahead.

6. Evaluation of the IPSP

As was explained in Chapter 4.4.1, the implementation of IPSP focused on the prioritized key areas of FPP, not to IPSP itself. Due to that, the implementation activities of FPP are evaluated first by using a quantitative method: available ICT resources in academic years 1999/2000 and 2004/2005 are compared statistically. After that IFIP is investigated in terms of its timetable, budget and technical solutions (plan vs. realization). Finally the situation of the implementation of IPSP is analyzed by comparing it to FPP and its implementation. This analysis answers to the second research question: How did the implementation of IPSP achieve its original goals?

6.1. ICT resources in 1999 and 2004

6.1.1. ICT resources for students

ICT resources for students' use developed from the year 1999 to 2004 as shown in Table 10 [14]. The comparison between the figures in the table and the number of students during same time period (Figure 6, p. 21) shows that the number of computers per student dropped from the ratio 1:6 to 1:10. The quality of the computers was higher in 2004 than 1999 due to their age, but their number did not meet IUCO's aim to have one computer for every six students.

Table 10: ICT resources for serving students in numbers.

Resource	1999	2004
Computers	30 (486-level)	73 (37 Pentium IV and 36 Pentium)
Server computers	none	2
Printers	4 matrix printers	2 laser printers
Data/video projector	none	1
ICT laboratories	1	3
ICT laboratory for teaching	1 (14 computers)	1 (21 computers)
Internet laboratory	none	1
ICT Service Center	none	1
Staff	none	1
Computers/students	1/6	1/10

The situation with the printers was same as with computers. IUCO had fewer printers available for students in 2004 than 1999, but their quality was better. Also the way how

printers were used in 1999 is different from 2004. In 1999, matrix printers were located in ICT laboratory, they were connected to individual computers and students moved them to the computers where they were needed. In 2004, laser printers were located in ICT Service Center, the documents were saved on diskettes and staff of ICT Service Center printed them out when asked. The arrangement was done because of the financial reason; for instance in 2004/2005 it was allowed for a student to print 240 pages without extra payment. Technically IUCO's network would have controlled the printing since the domain was operational in 2003, but it was been easier to control printing costs this way.

The number of ICT laboratories is not as important as the amount of resources allocated in them with one exception: ICT laboratory for teaching. The number of computers in this laboratory compared to the number of the students in classes is very important. The largest class in 1999 had 21 students and in 2004 139 students. Even if the class was divided into three groups in 2004, the ratio between the students and computers was much lower in 2004 than 1999.

There were 38 computers out of 70 connected to the internet at the end of 2004. Twelve of them were allocated to all students' use, five for journalism students' use, and twenty one for ICT teaching only. The number of computers connected to internet was limited to 12 computers, because of the available bandwidth.

The numbers above show clearly that the investments in ICT were not enough in the examined period, even though ICT services improved significantly in many areas. The reason for this unexpected result was the underestimation of the growth of the student enrollment during the planning period of IFIP in 2000. The student body in academic year 2004/2005 was 670 instead of the estimated 500 (Figure 6, p. 21).

6.1.2. ICT resources for staff

ICT resources for staff use developed from the years 1999 to 2004 as shown in Table 11 [14]. Comparison between the number of staff and ICT resources shows that ICT situation in 2004 was better than 1999. Comparison shows that two staff members shared one computer in 1999, but in practice the most of the computers available, 10 out of 18, were reserved for

administrative staff use only (in 1999 the total number of staff was about 45). Therefore, the academic staff shared the remaining eight computers and the ratio of computer per staff was about 1:4. The situation was different in 2004, when practically all the staff members who needed a computer for their work had it in their office (total number of staff was about 90 in 2004).

Table 11: ICT resources for serving staff in numbers.

Resource	1999	2004
Computers	18 (486-level)	72 (12 Pentium IV and 60 Pentium)
Server computers	none	1
Data/video projector	none	3
Printers	7 (6 matrix and 1 ink-jet printers	2 laser, x ink-jet and y matrix printers
ICT Service Center	none	2
Staff	none	2
Computers/Staff	1/4	1/1

The printing for academic staff was organized in the same way as for students, because of the very same financial reason. Only some members of the administrative staff had personal printers connected to their computers due to their need to print a lot or to print confidential material. Another improvement compared to year 1999 was that all staff computers were connected to the internet in 2004.

6.1.3. Shared ICT resources

Staff and students shared some ICT resources in the examined years 1999 and 2004, even though the only shared resource in 1999 was an ICT teacher (Table 12). ICT teacher had to take care of all the college's ICT resources because of the lack of other professionals. Later IUCO organized some shared facilities, such as a space for server computers and fixing computers. Also the internet connection was shared between all connected computers.

Table 12: Shared ICT resources in numbers.

Resource	1999	2004
Internet Connection	none	128/64 KB
Server computers	none	4
Computer Center	none	1
Maintenance room	none	1
Staff	1	5

As mentioned in Chapter 5.2.1, IUCO had five persons (four Tanzanians and one foreigner) working for its ICT department and three persons serving in IT Service Centers (see Table 10 and 11) in the beginning of academic year 2004/2005. This was a significant improvement compared to the year 1999, when all ICT activities were taken care of by one foreigner. Still the workload of ICT department at the beginning of the academic year 2004/2005 signaled that the implemented organization would not be enough for taking care of ICT teaching in the future: ICT teaching staff was already under maximum allowed workload (Table 13). The workload did not include any ICT training for staff due to the lack of time. ICT teachers would have had time for extra teaching activities during the breaks between the semesters and academic years only.

Table 13: Teaching workload of ICT staff in the first semester of the academic year 2004/2005.

Position	**Defined Maximum of contact hours**	**Contact hours**
The head of the department	6	6
ICT instructor	12	14
ICT technician	6	6
Volunteers	-	6
Total	18	28

The workload situation was similar in the ICT development and support as it was in the teaching. The responsibility of the computers and LAN maintenance was shared between Help Desk Person and ICT technician, but practically the head of the ICT department and ICT Advisor were participating in this work all the time. The main reason for the needed extra work was the old Pentium level computers whose maintenance was time consuming and not possible to do remotely.

The availability of the internet connection in the academic year 2004/2005 was significant improvement compared to the situation in 1999, when there was not connection at all. However, even if there now was connection, its ability to serve all connected computer (more than 100) was limited because of its bandwidth (Table 12).

6.1.4. ICT budget

The Student Computer Access Fee (60 000 Tanzanian shillings/year) has been included in the college's budget since the academic year 2002/2003 [71]. Before the fee was implemented, all ICT costs were covered by direct support from western donors. The half of the fee had been used for covering annual costs of the college's internet connection and the students' printing costs (Annex F). The rest of the fee had been used for maintaining computers and ICT development generally. The collected fund was not enough for covering all ICT costs such as ICT personnel salaries.

The budgeting for ICT was under the financial department's control during the research period and there was not any organized budged proposals coming from the faculties and the departments.

6.2. IFIP project and its extension

IFIP and its extension are evaluated from three different aspects: its budget, timetable and technical solutions. In the following chapter its effect on the implementation of IPSP is analyzed. The reason for this is that the project was only a technical part of its main project's implementation and its effects are meaningful only in the context of the main project.

The financial information of the project is collected in the Table 14 [23]. The table follows project years, not calendar years: for example the project year 2001 started in December 2001 and ended in March 2002. Also US dollars have been used instead of Tanzanian shillings or Euros, because it was the main currency when companies price the ICT items in Tanzania.

Table 14: Budgeted, received and used funding in years 2001-2004 (US dollars).

	2001	2002	2003	2004	2001-2004
Budget	33 280	36 110	37 091	17 610	124 091
- Investments	28 480	33 710	37 091	17 360	116 641
- Construction activities	4 800	2 400	-	250	7 200
Funding Received	29 920	31 600	44 660	20 583	126 763
Funding Used	32 946	28 480	44 854	18 118	124 398
- Investments	32 638	24 531	42 591	17 164	116 924
- Construction activities	-	3 939	1 561	0	5 500
- Bank Charges	308	128	65	254	755

Table 14 shows that the project followed its total budget very well, although with one exception. There are differences between the budgeted years and their funding. This variation can be explained in two ways: the implementation order changed from the planned as explained in chapter 5.1.1 and the delivery of some ordered items were delayed badly from their initial time of deliveries: for example, the software for ICT laboratory for teaching arrived as much as 1.5 years later than expected.

The comparison between the planned investments (Table 6, p. 34; 7, p. 36; 8, p. 40 and 9, p. 50) and the materialized investments (Annex E) shows that there have been only minor technical adjustments during the project implementation period. The only technical change inside the buildings is connected to the distribution of electricity to computers: the planned surge protectors were all replaced with UPS units. The electricity network influenced also strongly the decision to change the connection between the buildings from wireless routers to fiber optic cables (Chapter 5.4.1) [23]. The fiber optic cables were included in the original topology plan (Annex C), but they were replaced with wireless routers during the LAN wiring (Chapter 5.1.5). Finally fiber optic cables were installed because of the difficulties with the electricity. This arrangement cost about 2000 US dollars more than was budgeted originally, but it was possible to cover with the year 2004 funds, because of the advantageous exchange rate between Euro and US dollars.

The location plan for the multipurpose hall was designed later than the plans for other areas (Chapter 5.4.1), but they all were implemented without any modifications (Annex B). The situation with the implementation of topology was slightly different (Annex C and D). During the implementation more switches were used instead of hubs, because of their price. The price for switches had dropped down significantly during the year 2002 and the difference between

the price of switch and hub was only a few US dollars. The locations of the server computers were different in the implemented topology than the plan due to the lack of space in planned areas. Also the internet connection was implemented via the fixed land line instead of planned satellite connection.

The timetable of the project was modified immediately after the project acceptance due to the lack of time in year 2001 (Chapter 5.1.1). The late starting date of the project affected to the whole project schedule as seen in Figure 26. The project year ended in March and started in April.

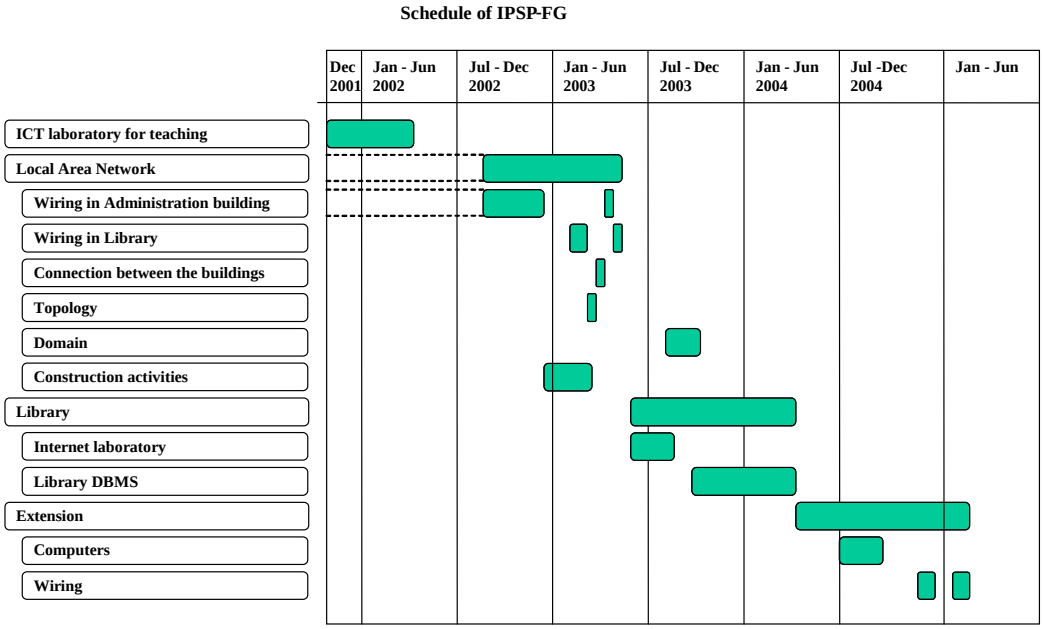

Figure 26: Materialized schedule of the IFIP.

The implementation activities met the annual schedule of the project very well even the implementers wrote to the annuals reports for Finnish government that there had been difficulties with some suppliers, who could not meet the initial time of delivery. The reason for the difficulties was seen to be the companies in Europe and North America, who did not see Africa as a priority market area for their products.

There was a break between the implementation of ICT laboratory for teaching and the wiring. The reason for the break was that I stayed in Finland five months in year 2002 due to the furlough break between my working periods in Tanzania as explained in Chapter 5.1.5. Without this five months period the project implementation could have followed the calendar year in 2002 and later.

6.3. IPSP and its implementation

The evaluation of FPP pointed out that its key areas and short term objectives were implemented during the research period 2000-2004 (Figure 8, p.26). IUCO modernized ICT laboratory for teaching (Facilities for ICT teaching), and implemented LAN (Foundation for TEL), the internet connection and library DBMS (Access to knowledge), and ICT department with allocated money for ICT in IUCO's annual budget (ICT department and budget). FPP´s short term objectives were the same as its key areas with one exception. IUCO has not started its own ISP or offering ICT courses for outsiders. The possibility to start ISP in Iringa was analyzed and found to be too risky, because of the small market area and lack of ICT staff available in Iringa region. ICT courses for outsiders were found to be an excellent idea, but they had not been implemented due to the lack of ICT staff in college until the end of 2004.

Almost all of the long term objectives of FPP were also implemented (Figure 9, p.27). The *Web site* of IUCO was opened in 2004 (Chapter 5.4.1), *the internet link* was sustainable due to the implementation of Student Computer Access Fee in 2002 (Chapter 5.2.1), and *staff training* was organized during the breaks between the semesters and academic years as explained in Chapter 6.2.3. *Co-operation with other universities* was also started, but it is difficult to measure exactly when IUCO's co-operation with other universities is seen to be adequate level. However, it is possible to say that the co-operation started with some other universities during the research period. The only long term objective that was not clearly implemented yet is *ICT budget from faculties.* The budgeting for ICT was done by the financial department (Chapter 6.2.4).

Evaluation of FPP´s implementation proved that the foundation for TEL (the last phase of IPSP in the Figure 7, p.24), was completed during the years 2000-2004. Also the results of the analysis of the long term objectives of FPP showed that TEL itself started, but its areas

Human Resource Development, Institutional Capacity Building and Infrastructure Development are continuing processes, not something that will be implemented totally at any time in the future.

7. Conclusions

The number of the computers for students' use increased remarkably in 1999 (Table 3, p.23), but this improvement did not help IUCO to modernize the way of using computers. They were still used mostly as typewriters for writing assignments and thesis. The problem was deeper than the lack of the computers: the written vision and plan was needed for guiding the ICT development in the college.

Consequently, Mr. Richard Ashford, a volunteer from USA, was hired by ELCA to assist IUCO to develop the plan for its' future ICT activities. Mr. Ashford stayed for about six months in Iringa and introduced the IPSP at the end of 1999. IPSP can be seen as the first ICT master plan of IUCO, because it defined the general vision, goals and objectives for IUCO's ICT development. However the ideas of how to use ICT in education introduced in IPSP were difficult to implement in practice, because the needed ICT facilities, except the internet connection, were not defined at all in the plan.

The main reason for the above said weakness was that it was published only a month after the planner's arrival to Iringa. There was not enough time for precise background analysis for the ICT situation in IUCO. This can be seen as an example of the misuse of a foreign expertise. The foreign expert prepared the ICT plan for IUCO as a consultant without real co-operation with the local community. This can also reflect the fact that there was not enough expertise in IUCO to utilize the foreign expert in a useful way.

Because of the difficulties with IPSP, the second ICT plan (FPP) was designed in the beginning of 2000. It was aimed to fill the gap between IPSP and IUCO's ICT situation. This plan Mr. Ashford prepared after visiting some East African Universities and discussing with the project organizing committee's members (Chapter 4.4.2). FPP defined four key areas, where to concentrate in three years period (Figure 8, p. 26): Local Network, Library Development, Computer Classroom and Technical Support.

FPP´s design was done in co-operations between the foreign and local experts. The foreign expert had enough time for proper background study and the local expertise was utilized

during the planning process. This led to the situation where the implementation process continued later without foreign expert.

FPP was concretized in implementation plans explained in Chapter 5: *Library Facilities Improvement Project, ICT Facilities Improvement Project, ICT department and its budget, and Internet Connection* (Figure 11, p. 30). The analysis of the first sub-project: *Library Facilities Improvement Project* was left out from more precise study due to the lack of connection to ICT in the research period. The rest of the subprojects of FPP were connected to ICT development of IUCO and also they were all the key elements of the implementation of IPSP. This perspective justifies their deeper analysis here.

The second sub-project *ICT Facilities Improvement Project* was aimed to build the foundation for all activities introduced in IPSP (Chapter 5.1). It had the central role during the implementation process of FPP. It was obvious for the implementers that up-to-date ICT facilities and support for their use were needed before ICT could be utilized in education more widely. Also the demands of sustainability of the project and the donor's definition for it (Chapter 5.2.1) created the strong links between this technical project and other projects of FPP.

The central role of the immigrated expert, as I was in this project, was seen as a problem when the fund was applied from the donor (Chapter 5.1.2). This was a surprise, because of the current position of the expert in the organization of IUCO. The position was clearly seen in IUCO as a staff member, not as a staff of Finnish NGO, temporary visitor or similar. This led to the practical solution where the project's organization was modified and headed officially by IUCO's provost. Also the donor's policy about the financial responsibility of the Finnish NGO affected to the implementer's role: I was responsible for the project to the NGO and the same time I could not lead the project officially because of the donor's policy.

Above mentioned dilemma affected the project's practical implementation in the beginning. I spent some of my working hours for doing the work that belonged to other personnel in IUCO's organization like bidding invitations (Chapter 5.1.4). This was learned to be too difficult and time consuming in practice. Later the implementation process led to the conclusion that the chosen technology should be sustainable also technically, not only

financially (Chapter 5.1.6). This means that there has to be enough local knowledge to maintain technical solutions and it is better to use available local materials.

The role of current infrastructure and physical environment should not be underestimated during the planning and implementation processes. It was learned that the quantity and quality of the available background information varies and that can affect to the implementation process significantly (Chapter 5.1.6). For example, it was not possible to get proforma invoices in advance for wiring work due to the lack of floor plans. In addition the electricity cabling was found to be poorly made and the grounding was not operational in many areas of the buildings. The lack of the needed grounding made UPS units, the most obvious technical solutions against electricity problems, useless. The physical environment (security, temperature, floods etc.) have to be analyzed carefully in advance (Chapter 5.1.8). This was learned during the implementation process in the library, when the fans were replaced with the air condition units and the security had to be improved through construction activities and security procedures.

The fluctuation in exchange rates can have significant impact to the long projects if their budgeting has to be done for several years in advance (Chapter 5.1.8). US dollar is the most commonly used currency when worldwide ICT companies are pricing their products. This is a problem when the US dollar based budget has to be converted to other currency for the approval. Fortunately fluctuation of the exchange rates gave a positive impact to this project and its financial resources increased.

When the options for the library DBMS were explored, it was learned that the open source software was not commonly used in Tanzania (Chapter 5.1.8). The reason for the situation was the widely spread illegal copies of commercial software. It was also noted that the graduated students were employed better with the knowledge of the commercial software than the open source software. Therefore the role of the open source software was limited only to the server computers.

The use of new technology can create new requirements in the middle of the implementation of the project which had not been taken into account earlier (Chapter 5.4.2). This happened during this project, when the journalists realized how useful tool the internet was for them.

The third sub-project *ICT Department and its budget* was aimed mainly to guarantee the long-term functionality of the on-going investments (Chapter 5.2). ICT department was organized as stated in FPP during the research period 2000-2004, but its duties were slightly different from those planned in IPSP. IPSP introduced the idea of an independent Computer Science Department aiming at a degree level education in ICT area, but this plan was not implemented. The statistics in Chapter 6.1.3 show that the implemented ICT organization was fully employed in academic year 2004/2005.

The most important lesson learned during the implementation process of ICT organization was that it is a long term procedure (Chapter 5.2.2). It was practically impossible to hire specialists to an institution which located in remote area of the developing country. The best option was to educate current employees and students to meet the needs. This kind of process required assistance from the co-operation partners who were not bound to only short-term results. This long-term commitment is important to recognize when sending expatriates to serve the co-operation partners. Short-term volunteers are important for specific projects, when their expertise can be transferred to locals, but more long-lasting effects and more sustainable development is gained when an expatriate commits to several years service.

The funding problem of ICT was solved in 2002 by adding Student Computer Access Fee for the student's yearly payment (Chapter 5.2.1). The evaluation of the used fund (Chapter 6.1.4 and Annex F) shows that the level of Student Computer Access Fee was not enough in 2004 to cover all ICT costs of the college. The situation would have been better, in terms of sustainability, if IUCO would have increased the fee on the demanded level. The budgeted fee should have included the salaries of ICT personnel and the fund for investments needed to keep ICT facilities on the up-to-date level.

The fourth sub-project *Internet Connection* was aimed to fulfill the goal of whole IPSP (Chapter 5.3). This goal was reached when IUCO got 128/64 Kbps (download/upload) shared landline link to the internet in August 2002. It was not defined exactly what this sharing meant in the agreement, but it was known that some internet cafés located in Iringa city center were using the same bandwidth as IUCO between ISP's headquarter in Iringa and the internet. IUCO had more than 100 computers connected to its bandwidth in 2004 and the estimated average download speed was about 600 bytes/second/computer, if 20% of the connected computers were sharing the bandwidth in same time period. This average estimation does not

give the whole picture of the situation, because the transfer rate could drop to 100 bytes/second/computer during the peak hours in the afternoons (almost all the connected computers were using the connection). Even though these figures are imprecise, they show that the bandwidth was not sufficient for IUCO. A way to estimate the needed bandwidth is to allow the same bandwidth per computer as traditional modem users had (28.8/56 Kbps). This basic information together with the above mentioned estimation that approximately 20% of the connected computers were using the bandwidth in the same time period, gives the speed range 512…1024 Kbps for the desired downlink speed in year 2004.

The communication between the people from different cultural backgrounds is a challenge. The differences between communication cultures and insufficient language skills can affect to the outcome of the co-operation process (Chapter 5.3.2). For example, the misunderstanding between two personnel affected IPSP in a way that three independent solutions to the problem changed to the steps for implementation. The difficulties were avoided in this project because of the long-time presence of the other foreigner. Without this, it could have turned the implementation of the internet connection even more complicated than realized.

The third research question was: Was IPSP successful in relation to the expectations of Iringa University College? The evaluation of the implementation of FPP proved that it was successfully implemented in the research period (Chapter 6). Also it was shown that the last phase of the IPSP is continuing process, not something that will be implemented totally at some point in the future. In spite of the successful implementation, IPSP had a serious weakness in it. The area called Institutional Capacity Building did not mention anything about ICT facilities needed for the college's administration. This lack affected all plans that were derived from it in terms of ICT. IUCO developed this area very little during the years 2000-2004. IUCO bought some new computers and printers for staff, but on the software level there is no difference compared to years 1999 and 2004. All financial information, students' information, assessments, timetables etc. were recorded in files in individual computers, not centralized databases.

The consequences of this weakness can be easily seen in the planned subproject of IFIP. All sub-projects were planned to develop ICT facilities for education only and there was no sub-project aimed to improve those facilities for the administration.

Also it can be seen that the number of facilities planned and implemented was insufficient to meet the requirement of the growing student body as explained in Chapter 6.1.1. The reason for this underestimation of the size of the student body is clearly shown in Figure 6 (p. 21). The estimation based on the years 1998-2000 predicted that the student body would grow by 20% per year, instead of realized 30%, and this growth predicted about 500 students for IUCO instead of actual 670 for the academic year 2004/2005.

8. Lessons learned

The last research question was: What can be learnt from IPSP in larger context? The answer can be found through the trends that hinder the use of ICT in developing countries: (1) available resources, (2) climate and environment, and (3) people and culture. They all have been noted in research literature and they are found in this research as well. Therefore, it is obvious that the successfulness of a development project depends on them. This leads to a question: how is it possible to minimize their impacts to developing projects?

(1) Normal project planning involves *an analysis of needed recourses* and there is no difference between developed and developing countries in this sense. It is obvious for an ICT professional that without certain amount of resources (personnel, funds etc.), it is impossible to implement any kind of ICT project. This planning procedure is similar in all countries and due to this reasons more precise analysis in not needed here.

(2) The climate and environment varies in different countries and one can not underestimate their impact on an ICT project. In a developed country, the indoor humidity, temperature and level of noise are well planned and controlled by others than ICT professionals. This is most likely not the case in a developing country and one has to analyze their impact on ICT equipment. Devices that protect ICT items against electricity breakdowns work only if the grounding of the electricity wiring is done properly. Because of this, one has also to know, how the changes of seasons affect the functionality of grounding. An additional surprise to an ICT professional can be various insects and small animals that can harm, for instance the cables. There may be a need to rewire the local area network or electric cabling unless they have been correctly protected.

The general level of infrastructure varies greatly in different areas; therefore the local know-how is important. Additional questions when planning an ICT project are, for instance how often there are power cuts, or is there electricity available at all. Or, how unstable the electricity is, what is the level of know-how of local constructors, are there local ICT professionals available? How to organize the support of investments? Is the intended purpose of ICT realistic also from the perspective of the investor?

The above mentioned questions are very concrete and tied to a certain existing physical environment. Learning them and paying adequate attention to them when planning and implementing and ICT project in a development country is, in my understanding, the first step in the process of enculturation and contextualization.

(3) However, considering the physical realities alone is not enough when aiming at contextualizing ICT. What has so far been lacking in ICT development project planning is the anticipation of the impact of cultural stress on a project, a factor that belongs to the third group (people and culture). For instance, when an expatriate is on the honeymoon phase, it is quite likely that he/she makes very optimistic plans, is perhaps overenthusiastic, and sees the possibilities and potential in too bright light. Crisis phase again has an opposite effect, and may also promote such negative actions and attitudes, that harm, for instance human relationships to the local partner – this is something that has large influence on the success of a project in a developing country where human relations are one of the most important societal values. More realistic and permanent foundation for a project is created by going through all the phases until the adaptation.

Moving to and living permanently in a foreign culture is a challenge itself and one should not underestimate the stress it generates. My adaptation in Tanzania took nearly four years even if the first year was relatively easy: everything was new and exciting, and, for instance Tanzanian nature is unique and people hospitable. However, the attracting of novelty fades away in time, and true adaptation begins after that. The most challenging part of this is to learn to understand different value systems: which parts of your own values are of little importance in another cultural environment, and which values again are so elementary that you can not reject them. This becomes crucial especially in ethical questions. People, their values, traditions, beliefs, religions, family ties etc - the whole reality of human society - has to be learnt and appreciated genuinely if we want to participate and collaborate in the field of development work, education and ICT in such a way that it truly and permanently promotes positive changes in a society.

Another important factor that has not been fully understood in the international development co-operation is the different role of a long-term missionary compared to short-time development consultant. When a consultant is involved in a development project, his/her role is seen as a facilitator who needs to empower the local partners to manage and implement the

project by themselves. Also his/her working period is in most cases only couple of years, and his ability to contribute to the project depends on, on which stage of cultural stress he/she is. In that sense, his/her role is inevitably one of an outsider.

However, when a mission agency sends an employee, the expectation is that he/she can commit him/herself at least for 10 years time and thus the person becomes an integral part of local community and is not seen merely as a facilitator, but an employee. Therefore, it is natural that a missionary should have all the opportunities to plan, manage and implement a project as any other local partner would do, without the need to conceal it somehow for the sake of his/her foreign origin.

Value systems are always present when we implement practical projects, especially when acting partners come from different cultural backgrounds. Understanding this on a deep level is very important for the success of the project, and it is my conviction that knowing about different values and understanding them are two clearly separate things. Even if the cultural adaptation process explained in Chapter 2 is always personal and individual, I dare to say that it is not possible to go it through in less than three years. This claim is not based only on my personal experiences during the researched process, but also on practices of FELM introduced in Chapter 5.1.1.

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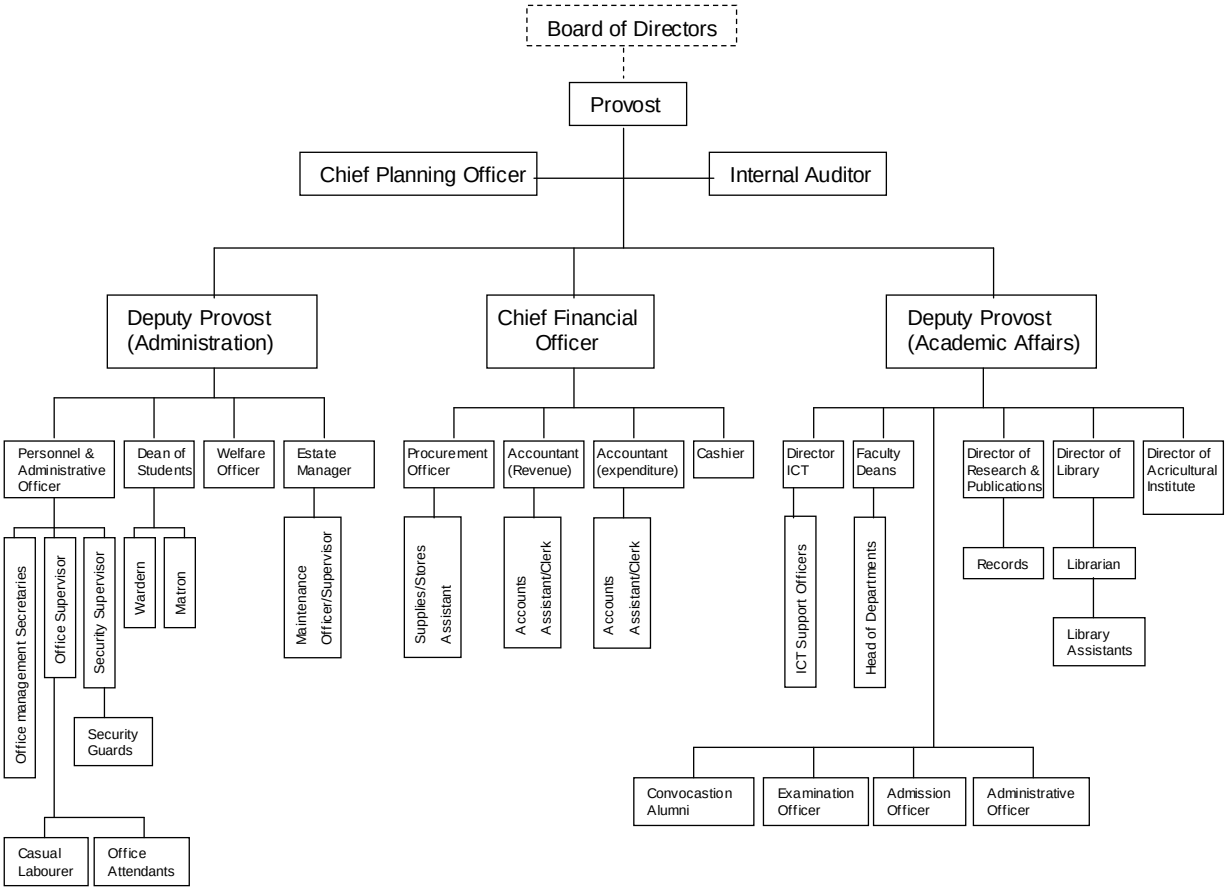
Annex A: IUCO's organization



Annex B: Location plan

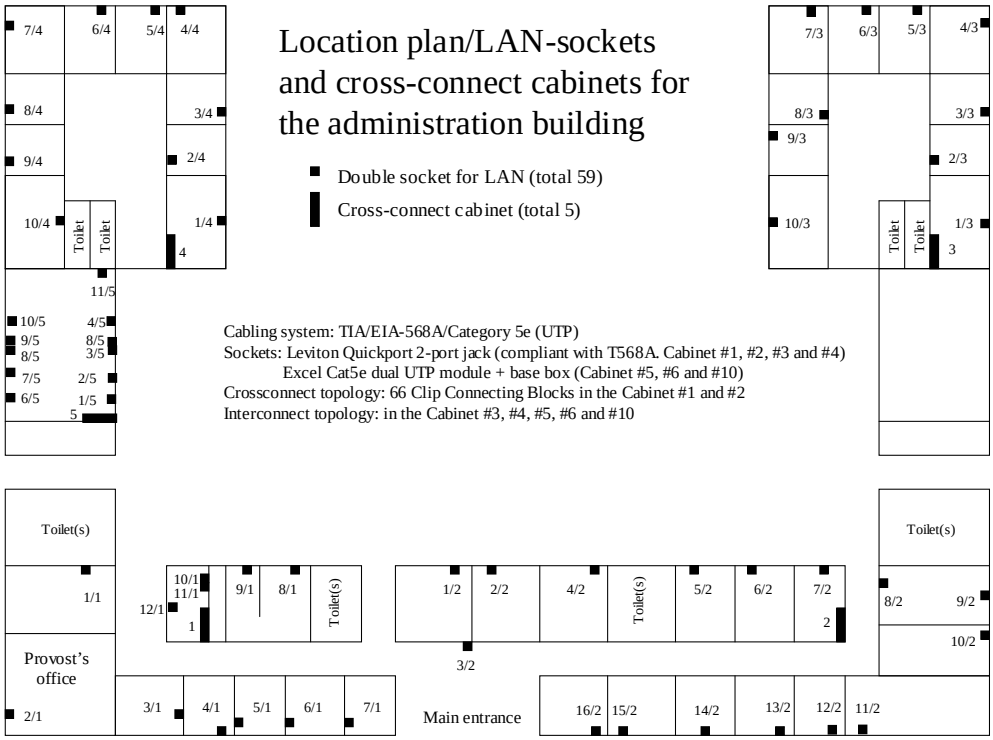


Figure B. 1: Sockets and cabinets, location plan for the administration building.

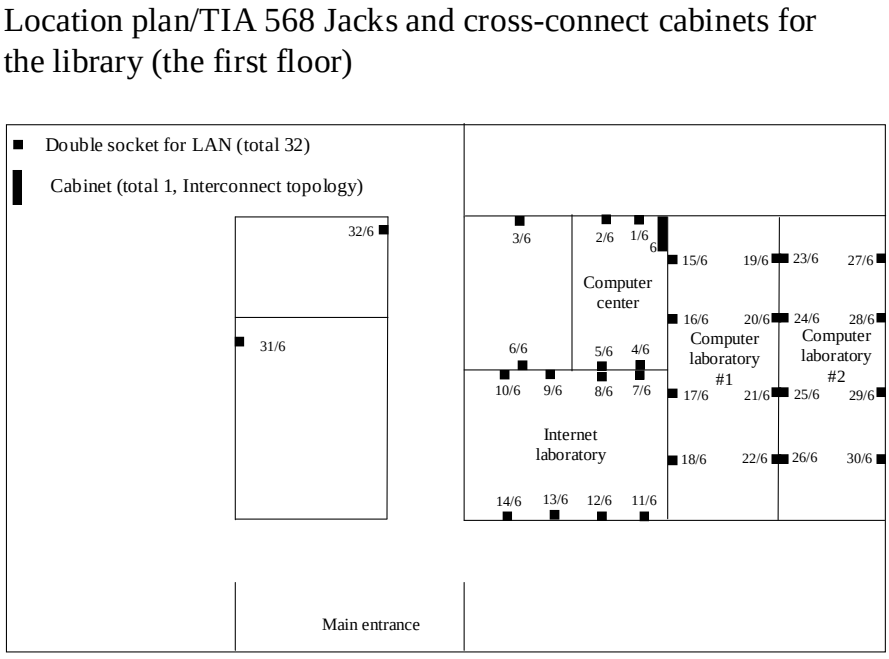


Figure B. 2: Sockets and cabinets, location plan for the library (first floor).

Location plan/TIA 568 Jacks and cross-connect cabinets for the library (the second floor)

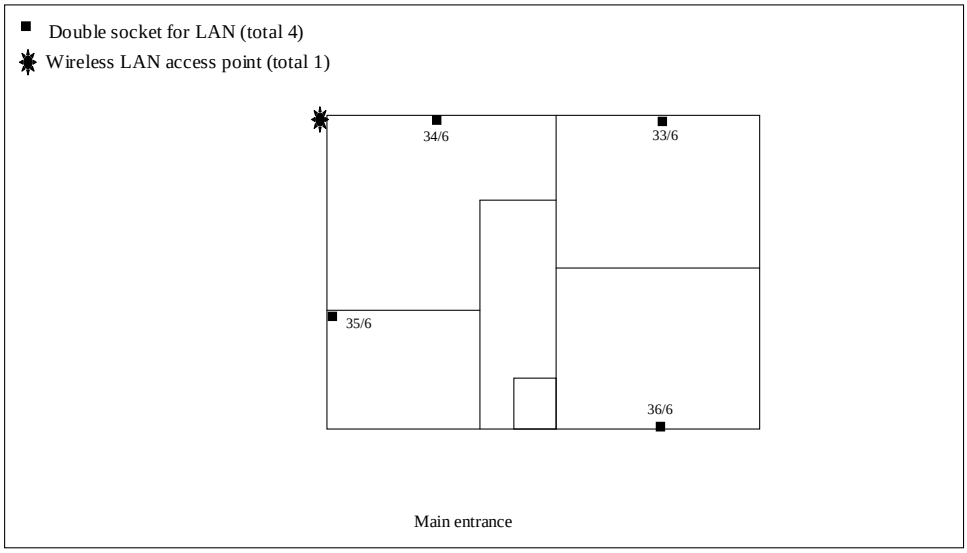


Figure B. 3: Sockets and cabinets, location plan for the library (second floor).

Location plan/TIA 568 Jacks and cross-connect cabinets for the multipurpose hall

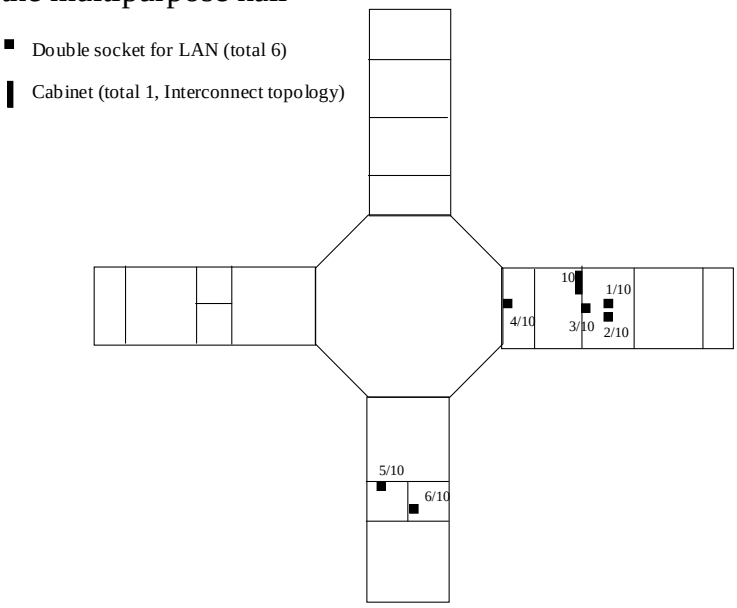


Figure B. 4: Sockets and cabinets, location plan for the multipurpose hall.

Annex C: Topology plan

LAN topology/devices for the internet connection

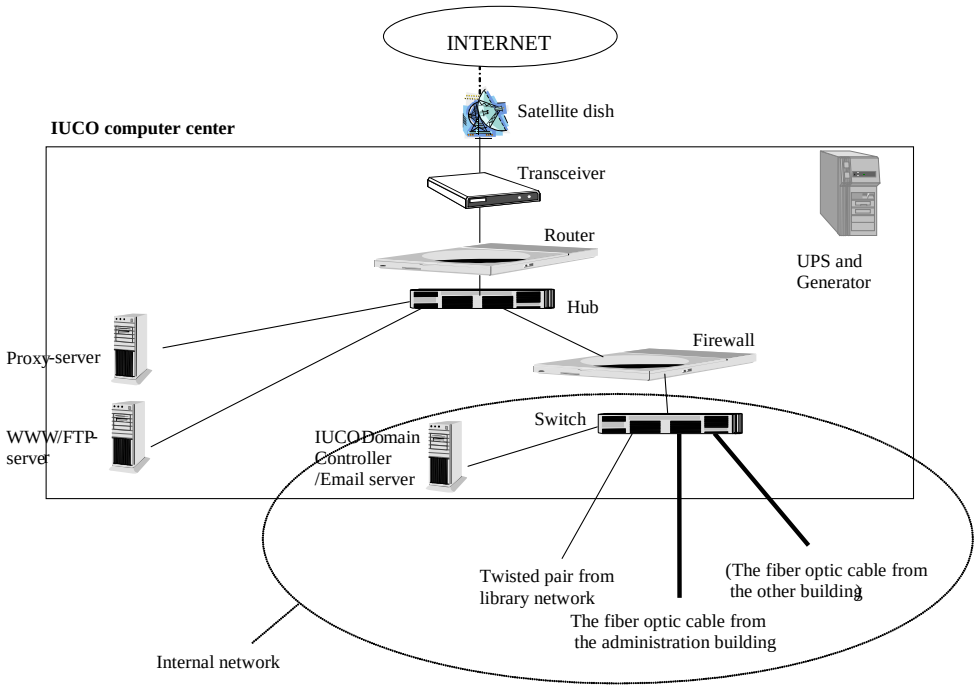


Figure C. 1: Topology Plan for the internet Connection.

LAN topology/devices in the library

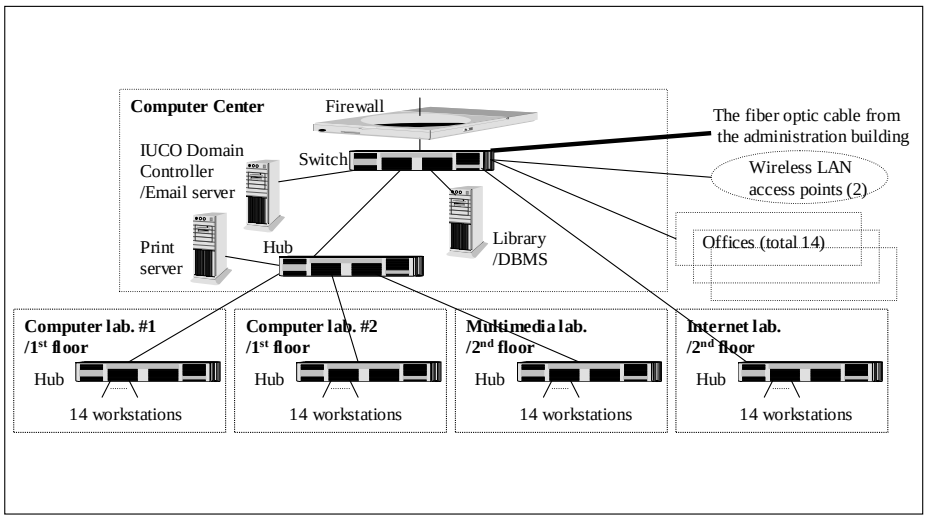


Figure C. 2: Topology Plan – the library.

LAN topology/devices in the administration building

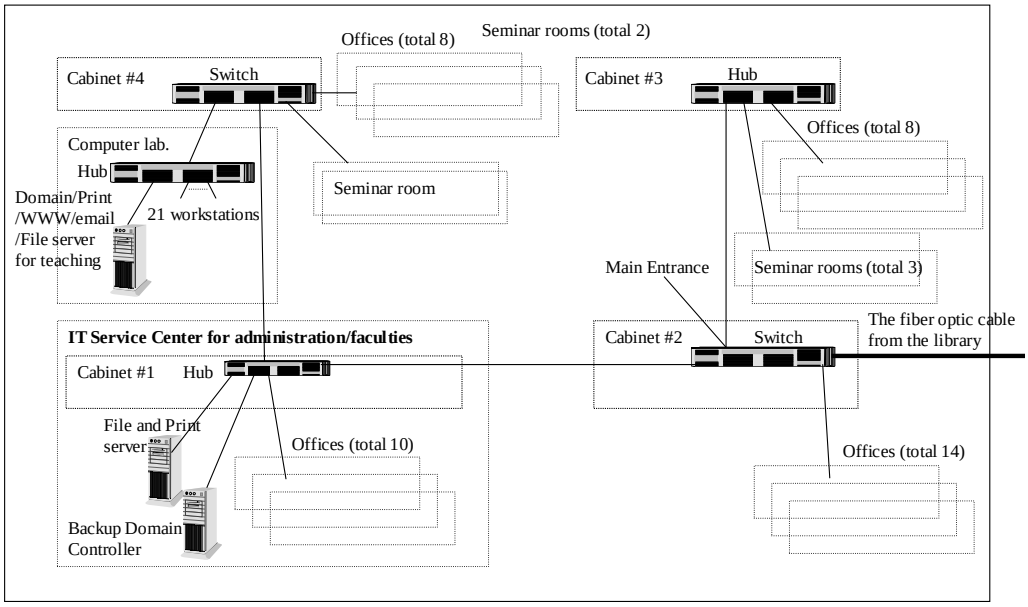


Figure C. 3: Topology Plan – the administration building.

Annex D: Implemented topology (in the end of 2004)

LAN topology/devices in the library

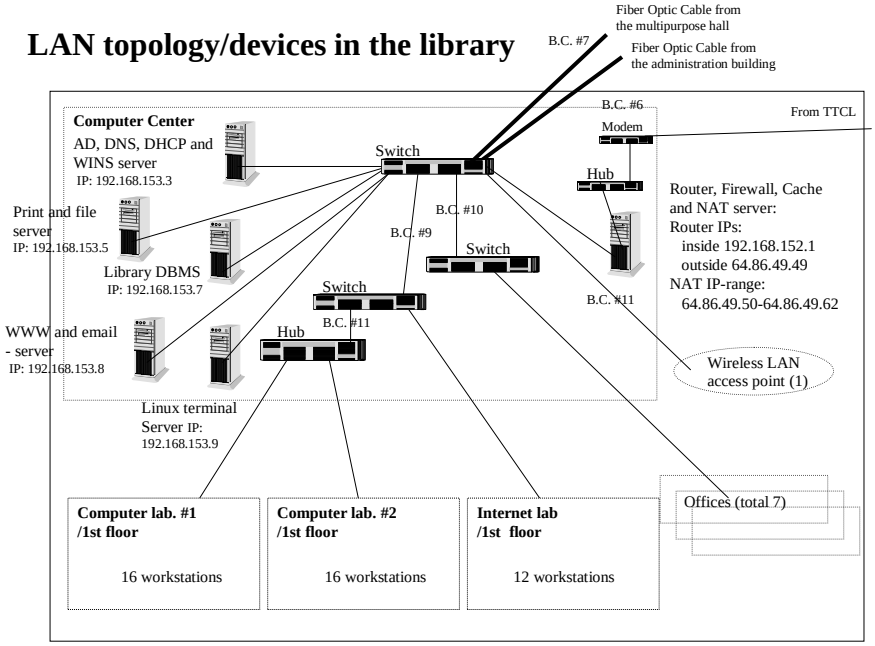


Figure D. 1: LAN topology in the library.

LAN topology/devices in the administration building

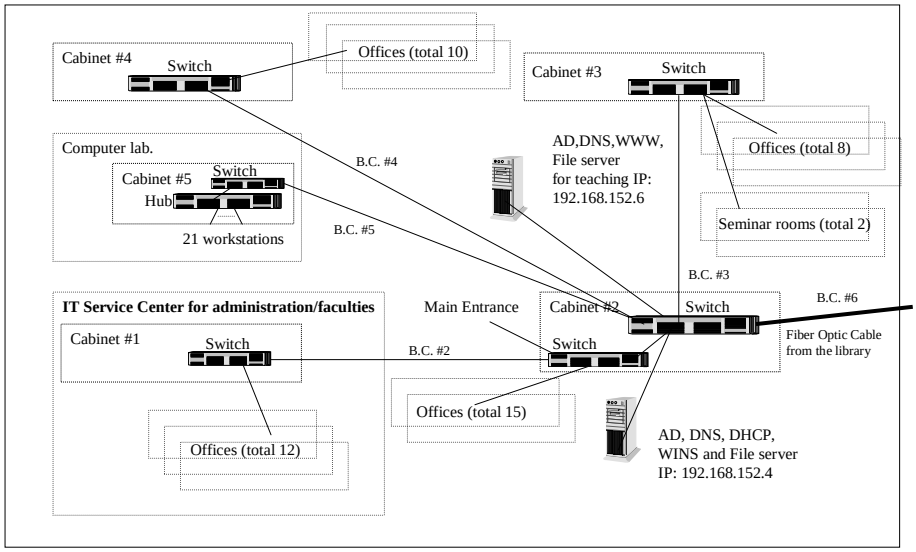


Figure D. 2: LAN topology in the administration building.

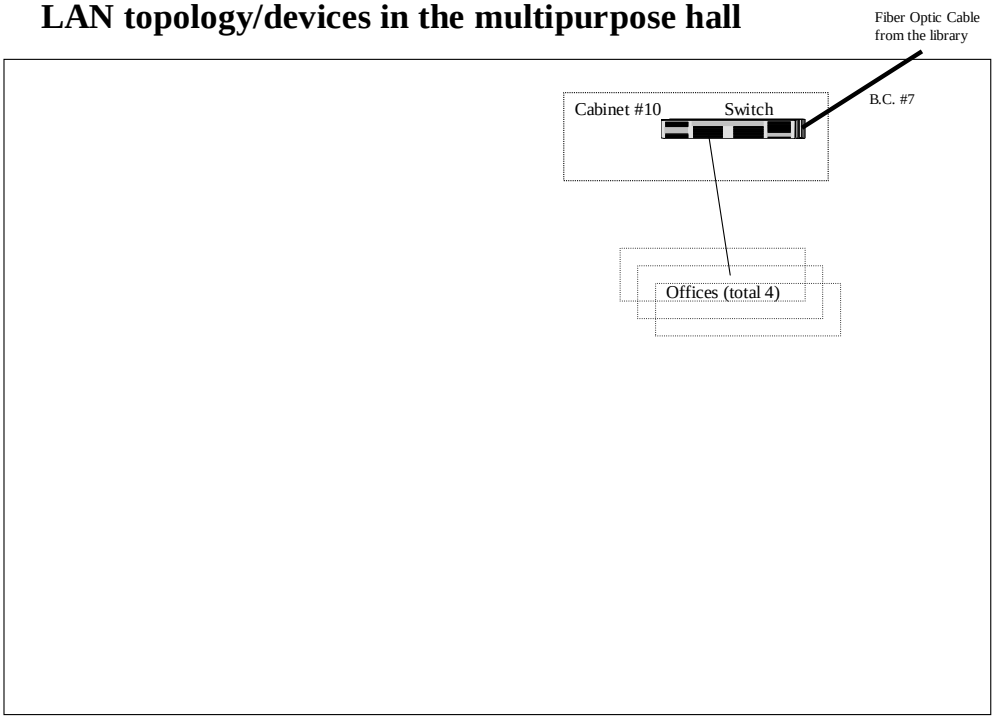


Figure D. 3: LAN topology in the multipurpose hall.

Annex E: Materialized investments and procurements in the Finnish government funded project

A5: Investments and procurement

Investments	-N-	Source	Number and quality of units	Unit Cost	Freight, etc.	Total costs
Year 2001						
Computer laboratory						
Equipment, machinery, and materials:						
Server computer, Compaq D300 PIV 1.6GHz		CyberCom Tanzania Ltd	1			1 888
* 256 MB, 40 GB + 20GB, CD-ROM + CDR		/Dar es Salaam				
Workstation, Compaq D300 PIV 1.6GHz		CyberCom Tanzania Ltd	21			26 736
* 128MB, 20GB, CD-ROM		/Dar es Salaam				
* Windows XP Professional English Intl.						
Accessories						3 700
* APC 1KVA Smart UPS		CyberCom Tanzania Ltd	2			
* APC 650VA UPS		/Dar es Salaam	10			
* HP LaserJet 1200 printer		CyberCom Tanzania Ltd	1			
* 3Com 24-Port 10/100MBPS Hub		/Dar es Salaam	1			
* Extension cords		Amani stores/Iringa	11			114
Basic installation is included in the prices						
Total costs					200	**$32 638**
Bank charges year 2001						$307,5
The funds for the year 2001 (USD 29920;- = FIM 200 000;-) have all been used in this phase.						
The extra funding (USD 3025,5) that was needed to implement this phase was taken from the year 2002 budget.						
Year 2002						
The funding received in year 2002: EURO 34376 = USD 31600 =>		**USD/EURO = 0,91925**				**$31 600**
The extra funding (USD 3025,5) that was needed to implement the year 2001.						**$3 025,5**
Investments						
Server computers for Administration building and Library						
Compaq ML 310T Server		CyberCom Tanzania Ltd	3	3 900		11 700
´- PIV/2.0GHz/512MB/18GB/17" monitor/CD-RW						
DAT Drive 12/24GB		CyberCom Tanzania Ltd	1	850		850
APC 1000VA UPS		CyberCom Tanzania Ltd	3	470		1 410
						$13 960
LAN for Administration building and Library						
Swithes 24-port		CATS Tanzania Ltd.	8	305		2 440
Swithch 8-port		CATS Tanzania Ltd.	1	95		95
APC surge protector		CATS Tanzania Ltd.	4	50		200
Cat5e 305m UTP cable		CATS Tanzania Ltd.	2 440	0,21		520
Double sockets		CATS Tanzania Ltd.	50	13		650
Base boxes		CATS Tanzania Ltd.	50	0,84		42
Speedlan 9101 wireless router		CATS Tanzania Ltd.	2	1 417		2 834
Installation kit 100 outdoor for Speedlan 9101		CATS Tanzania Ltd.	2	248		496
Compaq wireless LAN for library with 1 wireless access point and 5 wireless PCI adapters		CATS Tanzania Ltd.	1	1 560		1 560
Cabinets for LAN		Felix Mandela Furniture Mart	1	20		20
Trunking cables, screws, congrete plugs and tools for wiring		Amani stores/Iringa	1	277		277
Freight from Dar es Salaam to Iringa			1		160	
					160	**$9 294**
Other investments						
- Covers for 22 computers (IT laboratory)		Kabeya Gen Enterprises	1	67		67
- APC UPS units for Internet laboratory		CyberCom Tanzania Ltd	6		10	1 200
					10	**$1 277**
Investments Grant Total						**$27 557**
					EURO:	**29 977**
Construction activities:						
IT laboratory in Administration building						
Enhanced physical security.						
- Grilling computer room doors		Iringa Steel and Metal Works	1			231
- Grilling computer room windows		Iringa Steel and Metal Works	1			1 733
IT Laboratories and computer centre in Library						
Enhanced physical security and wiring (electric)						
- Renovation of computer laboratories		Chang´a building contractors	1			1 534
- Grilling the doors from Computer Centre and Internet laboratory		Iringa Steel and Metal Works	1			441
						$3 939
Construction activities Grant total						**$3 939**
					EURO:	**4 285**
Bank charges year 2002						$128
					EURO:	**140**
Total funding used from year 2002 budget						**$31 624**
					EURO:	**34 402**
The extra funding needed: (this was taken from the year 2003 budget).						**$24**
					EURO:	**26**

Year 2003

The funding received in year 2003: EURO 41051,57 = USD 44660 =>	**USD/EURO = 1,08789**				**$44 660**
The extra funding (USD 24) that was needed to implement the year 2002.					**$24**
Investments					
Internet/multimedialaboratory in Library					
Workstation, Compaq D300 PIV 1.6GHz	CyberCom Tanzania Ltd	12	1 200		14 400
* 256MB, 40GB, DVD-ROM, 17" monitor, Mouse, Keyboard	/Dar es Salaam				
* Windows XP Professional English Intl.					
APC 650VA UPS		12	120		1 440
					$15 840
Server computer for library management system					
Compaq ML 310T Server	CyberCom Tanzania Ltd	1	4 700		4 700
´- PIV/2.0GHz/512MB/3*36GB/17" monitor/CD-RW	/Dar es Salaam				
- DAT Drive 20/40GB					
ATA disk 40 GB		3	225		675
HotPlug disk 36GB		3	370		1 110
HotPlug Cage		1	550		550
Spare SCSI disk		1	425		425
APC 1000VA UPS		1	430		430
					$7 890
Circulation/Firewall workstations					
Clone computer PIV 1.8GHz	ATMA Electronic&Software Ltd./	2			1 619
* 256MB, 40*2GB, CD-ROM, Mouse, Keyboard	Mbeya				
Barcode reader	Computer Connection Ltd.	1			350
					$1 969
Software licenses					
Software licenses/Belongs to 2001 project (delivered 2003)	CyberCom Tanzania Ltd	1			1 373
	/Dar es Salaam				
					$1 373
Library DBMS/Koha					
Installation, modification, software delivery and travelling costs	4 C Center/Jyväskylä, Finland	1	11 000		11 000
					$11 000
Other investments					
Laser printer HP 4200	CyberCom Tanzania Ltd	1	1 100		1 100
					$1 100
Investments paid by IUCO and invoiced from the project					
Computer supplies	CyberCom Tanzania Ltd	1	684 400		
Cabinets for LAN	Felix Mandela Furniture Mart	1	188 400		
AC units for computer lab and Computer Center	Dallas Investment	1	2 740 000		
A shelf for Computer Centre	Felix Mandela Furniture Mart	1	130 000		
			TSH: 3 742 800	rate: 1094.72 (NBC 31.3.2004)	**$3 419**
Investments Grant Total					**$42 591**
				EURO:	39 150
Construction activities:					
Constrution activities paid by IUCO and invoiced from the project					
Fabrication and fixing of door and window grills to the IT service center	Iringa Steel and Metal Works	1	400 000		
Renovation for computer room	Chang´a building contractors	1	166 890		
Installation of the AC units	Chang´a building contractors	1	378 000		
Rehabilitation of the computer lab in the library	Chang´a building contractors	1	435 000		
Partitioning Computer Center for securing the servers	Ropert Mwambeje	1	115 400		
For protection of LAN cables	Felix Mandela Furniture Mart	1	34 000		
Securing windows in library	Chang´a building contractors	1	180 000		
			TSH: 1 709 290	rate: 1094.72 (NBC 31.3.2004)	**$1 561**
Construction activities Grant total					**$1 561**
				EURO:	1 435
Bank charges year 2003 from A3					**$65**
				EURO:	60
Auditing charges from A2					**$600**
				EURO:	552
Total funding used from year 2003 budget					**$44 817**
				EURO:	41 197
The extra funding needed: (this was taken from the year 2004 budget).					**$157**
				EURO:	145

Annex F: ICT expenses in academic year 2003/2004

Internet Costs	
Monthly connection charges	720 000
for a year	12
Total connection costs	**8 640 000**
Paper Costs	
Number of Students	580
Times, pages per academic year	240
Pages per academic year	**139 200**
Divided by, 500 pages per ream	500
Reams per term	**278**
Times, cost per ream	4 200
Total paper cost	**1 167 600**
Toner Costs	
Number of pages per academic year	139 200
Divided by, pages per cartridge	2 500
Number of cartridges	**56**
Times, cost per cartridge	110 000
Total toner cost	**6 160 000**
Total Internet/Printing Costs	**15 967 600**
Divided by Number of Students	580
Internet/Printing Costs per student	**27 530**
Personnel Costs	
Salaries for 4 ICT personnel	11 978 832
Total personnel cost	**11 978 832**
Maintenance	
Spare parts (hard disks, mice, power supplies etc)	555 800
Repairing ICT items (printers, photocopy machines etc.)	860 000
Other expences (hiring of external machines)	285 000
Total maintenace costs	**1 700 800**
Investments	
ICT items (computers, monitors, UPS units etc.)	13 468 731
Radio Studio Project	3 571 872
Other investments (disketts, cds, etc.)	225 000
Total investment costs	**17 265 603**
Total Personnel/Maintenance/Investment Costs	**30 945 235**
Divided by Number of Students	580
Personnel/Maintenance/Investment Costs per students	**53 354**
Total ICT costs per student	
Internet/Printing Costs per student	27 530
Personnel/Maintenance/Investment Costs per students	53 354
Total ICT costs per student in academic year 2003/2004	**80 884**