A CASE STUDY IN MALAWI

WIRELESS INTERNET IN THE UNIVERSITY OF MALAWI: CHANCELLOR COLLEGE

The project was presented at ICTP in Trieste by **Dr Chomora Mikeka** of Chancellor College, University of Malawi Department of Physics.
Most of the national development initiatives are done by help of the Research Institutions of Malawi University and, in particular, by the active involvement of Chancellor College (constituent college of the Malawi University). There exists at Chancellor College a newly commissioned VSAT network 256/128 K; as the connection to VSAT network is expensive (1600 US$/month) and discourage existing demand, the project has the objective of demonstrating the usefulness of wireless protocols in accelerating access, the reduction of cost for the Campus network and the benefit to rural communities that suffer inadequate communication support. The program is intended to:

- provide wireless access to Colleges for Departments, staff, students, offices
- extend wireless service to Agricultural Sector
- Reducing the great cost for the existing VSAT network connection.
- Connecting, outside the college campus:
  University of Malawi Central Administration Office
  National Statistical Office
  Department of Lands, Physical Planning and Surveys
  Department of Prisons
  Domasi College of Education
  Lecturers' and Professors' Residence

The project will be implemented in two phases. The first one will provide wireless network within an area of 40 km (3,6 Km radius from the Chancellor College). The objective is to increase access by100% in order to meet the present demand for Internet and e-mail client access. Clients are ready to pay for the service. The second phase will provide wireless service as a last mile solution for the agricultural extension workers in Machinga Agricultural Development Division (Fisheries Department) to monitor the efficiency increase in the Sector. Later on Agricultural Research and Extension Trust, Animal Health & Industry, Veterinary Department and Agricultural Rural Development Project will be connected.
Users, living and working in the Campus, can move inside the Campus, while maintaining connectivity to the network. Teachers, Staff, Students and public can safely access Internet as to derive an improvement in their working efficiency. Some of the immediate and measurable

results include: economies in intermediate consumption, less time wasted when applying Library, more documents produced, easier way for self-training, sharing of common files.

Approach to project feasibility
Economic feasibility of proposed project can be estimated by comparing the cost of additional network and the central equipment with the economies (benefits in monetary terms of communication, self-teaching, educational, training) it can provide. The estimate is made by using the IRR (Internal Rate of Return) model that compares, over a chosen study period, investment (initial cost), operating cost (maintenance, management) and expected revenue (quantification of benefits in monetary terms). The IRR is the discount rate that lets calculate the Net Present Value (NPV) of a series of cash-flows (expenses minus revenue) as to compare expected future income to certain initial investment.

Investment and annual expenses
According to the presentation of project given in Trieste, a first step of plan implementation (to be completed by 2005) covers the connection of three Corporate Institutions with 60 client-terminals. A second phase (to be completed by August 2006) involves the provision of wireless service (as last mile solution) for the agricultural extension workers in Machinga Agricultural Development Division (ADD).
The cost of first phase can be separated as follows:

Capital cost – Cost for purchasing a Central Unit and Web hardware and software. Figures have been taken from current literature and account, waiting for real information, as 16500 US$ for Central Unit, 8000 US$ for Web server hardware, 5900 US$ for Web server software, 7600 US$ for Content Creation and 22000 US$ for training cost. Total cost is **60000 US$** to which must add **12000 US$** for installation (20% of capital cost).

Network cost – Investment cost covers: “Access point” (**1200 $** =3x400), “Antennas” (**510 $** =3x170), “Network” (**585 $** =3x195) “Wireless client server” (**1005 $** =1x1005), “Installation, training” (**2400 $** =1500 + 300x3). Total investment declared is: **5700 US$;** nothing was said about other equipment (Central Unit, i.e.) to install.

Operating cost – Connections are maintained and operated from central node: relevant annual expenses might be estimated at **1140 US$** (20% capital cost).

Terminal individual cost - cost of a new PC together with relevant facilities (e-mail, training, database access): **1200 US$**. Total is **72000$** (=60x1200).

Estimate and quantification of benefits
The analysis concerns: Schools, Agricultural Sector and external Organisms. No information were given about the number and the activity of potential users by category or by Sector, so that it becomes difficult to evaluate total benefit. Some main concepts will be set out: until real input data are available from the field, relevant analysis is carried out using a number of reference Annexes which serve to show the process.

Inside the **Campus**, the expected users are: Teachers, Administrative Staff and Students. A tentative separation of working time per kind of user is given, in detail, in **Annex 1**.

1. the School save money as Teachers, Staff and Students, under the new facility, have less recourse to the so-called "intermediate consumption" (telephone, fax, courier, photocopies). **Annex 2** shows hypothetical situation before & after the implementation of facility.
2. Applying Library is justified by the need of getting information, of self-training, of updating files etc. **Annex 3** describes hypothetical benefit coming back to all categories of users. Total requests arriving per day were estimated as **50** and are supposed to be raised, on annual basis, by Teachers and Students.
3. The availability of files on line lets speed up working processes especially when preparing and circulating documents. **Annex 4 and Annex 5** shows hypothetical advantages coming to Teachers and Administrative people who can improve their working efficiency.

Malawi is a country where **rural** community accounts for 80% of total population whose production contributes as 30-40% to GNP. It appears, then, important to plan the extension of IT facility to agricultural workers in the remote or rural area. The need (that should be quantified) of this category concerns the access to: meteorological info, land management, pest control, food security modes, market and price models. Benefit is measured, firstly, as time saved when replacing trips (markets and fairs) and occasional contacts with experts by regular and prompt access to on-line information. The indicator is difficult to estimate without a close knowledge of local activity. Its quantification is related with average current salary.

Other people will add up as estimate of **external** users located in the Public Organisations (National Statistical Office, Department of Lands Planning, Department of Prisons). The extension of facility to people working out of Campus may provide a benefit to project in real monetary terms. If, per each connection, "N" clients have to pay a monthly subscription of 350 $/line, Chancellor College can enjoy an annual sum proportionate to **350xNx12**.

Schools: Teachers – estimating benefits

Basic activities of Teachers deal with their fundamental duties (**Annex 1**). Such an activity does not take advantage from the availability of Internet. Rather, there are a number of complementary activities (attending Seminars, participating to Congress, prepare lectures, research text/information, write documents/books) where access to Intranet turns to be the appropriate support to short down working processes and facilitate access to information.
The assumed salary is **300 US$/month**; the cost per hour is 4,17 US$/hour (=300x12/864).

Intermediate consumption – The lower recourse to intermediate consumption is quantified, in monetary term, with reference to unit salaries. Benefit to School coming from reduction of intermediate consumption accounts (**Annex 2**) for **82,56 US$/year** per Teacher. It corresponds to **2,29 %** of annual salary (=82,56/300/12) of one Teacher. Total saving is proportionate to total number of Teachers involved.

Queuing at Library - the project lets Teachers save 1,20 (=60x(0,10-0,08)) minutes for queuing (**Annex 3**). On a year basis, it becomes **23,04 hours/year** (=1,2x6x6x4x8/60) corresponding to a saving in the working time of **2,67 %** (=23,04/864). Into economic terms, such saving

per Teacher represents **96 US$/year** (=23,04x4,17). Total saving is proportionate to total number of Teachers involved.

Producing documents – It is supposed that, under paper-based process, 1,33 documents arrive in the reference hour (derived from Annex 2) and that 1,50 documents can be completed in the same time (**Annex 4).** During the period dedicated to this activity**,** Teachers are engaged at almost 89% of their working time. Under automatic procedures, the situation changes and Teachers can perform the same actions in less time: number of Teachers idle move, in fact, from 0,11 to 0,18 with an increase of 0,07. Corresponding time saved is 4,2 minutes per hour which turns to be **80,64 hour/year** (=4,2x6x6x4x8/60) that represents an increase in efficiency of **9,33**% (=80,64/864). In monetary terms, the saving is **288,23 (=80,64x4,17) US$/ year** per Teacher. Total saving is proportionate to total number of Teachers involved.

School: Students – estimating benefits

Fundamental activity of Students is: to attend classes, to meet regularly teachers, to get ready for examinations. Out of such duties (**Annex 1**), the activity that gets profit out of the new facility (Internet) available concerns: apply School library, get information, prepare documents.

Intermediate consumption – benefit coming to School when Students reduce intermediate consumption (internal courier, photocopies) is given in **Annex 2**; total saving gives an amount of **13,44 US$** per year and per Student. Total benefit is proportionate to total number of students involved.

Impact of new facility - like Teachers, students can save part of their working time when accessing library under automatic procedures. The queuing model (**Annex 3**) shows that, compared to paper-based process, the waiting time for students reduces by **1,2** (=60x(0,10-0,08)) minutes per hour, that is **23,04 hours** (=1,2x6x6x4x8/60) per year and per Student. Benefit coming back to Students is a time saving of **2,43%** (=23,04/948).

School: Administrative staff – estimating benefits

The main activities of administrative personnel concern: run accounting, deliver documents, manage personnel, deal with suppliers (orders, supply, payments), prepare salaries (**Annex 1**). For all of these duties the work automation lets saving time and improve efficiency.
Assumed salary is **150 US$/month**; the cost per hour is **1,47 US$/hour** (=150x12/1224).

Intermediate consumption – the reduction of intermediate consumption by Administrative Staff provides to School a benefit of **127,68 US $** (**Annex 2**) per employee which corresponds to **7,09%** (=127,68/150/12).of unit annual salary. Total saving is proportionate to total number of Administrative Staff involved.

Producing documents - Administrative people is supposed to concentrate main activity into producing document rather than applying Library. **Annex 5** assumes that 2,11 documents/files arrive in the reference hour (derived from Annex 2) and that 2,73 documents/files can

completed/updated within the same time: personnel is engaged at 77% of their working time. Moving from paper-based to automatic process, Administrative people can increase their idleness from 0,23 to 0,28 with an increase of 0,05. This corresponds to a saving, in monetary terms, of **90 US$/year** (=0,05x150x12). Translated into hours, the figures gives a saving of 61,22 hours/year that takes to an increase in efficiency of **5,00%** (=61,22/1224. Total benefit coming to School is proportionate to total number of Administrative Staff involved.

Rural Farms - estimating benefits

All activities performed by agricultural people can take advantage out of the introduction of work process automation. Potential benefit will come back to the Provider of service. From recipient point of view, savings in time is significant as efficiency may raise up.

Telecommunication consumption – As rural people leave under lack of communication facilities the introduction of IT system will surely improve the recourse to consumption. A survey, even provided through a limited number of location, may show which is the compressed demand and which consumption might be the expected. The Provider will take advantage out of the project in terms of revenue.

Impact of Internet - to estimate the benefit that the project takes to rural people a measure should be made of time necessary and sufficient to get appropriate information. Whether to do this, people have move out of their own place (go to fairs and market; meet experts) an economic benefit is expected in case the information are accessible at home through Internet. The saving in terms of money (avoiding most of trips replaced by accessing Internet) and of time (more presence in their location) turns into an increase in efficiency. A gross estimate of benefit, before looking into the practical results, may be assessed by a proportion between working time and GDP produced.

External users – estimating potential revenue

The extension of facility to people working out of Campus may provide a benefit to project in real monetary terms. If, per each connection, clients have to pay a monthly subscription of 350 $, annual revenue coming back to Chancellor College are **4200 $/year** per connection.

Conclusions

Feasibility of project is calculated in **Annex 6.** The working hypothesis is made that one Central Unit is installed, ten different sites are connected and 350 new PC are completing the network. Investment are derived from current experience and from the cost indicated in the project; operating cost corresponds to the salary of 4 people, revenue are assumed as the sum of benefits earned by the College.

Under these input conditions, the IRR model produces a return of –14,98%. The negative sign means that total economies, previously quantified, are not sufficient to balance total expenses incurred in the project over time. From economic point of view, the project provides internal economies that let partially recover the expenses involved by the project. As well, Teachers and Administrative Staff improved their efficiency in their activity so as to provide better care and assistance to Students.

Negative IRR does not necessarily mean that the project must be given up.

100% of capital concentrated at year zero; change of operating expenses
The IRR model lets assess the effect of variation into the operating expenses. Two alternative hypothesis have been checked with respect to the basic solution above. By the first one, the annual cost of 2 people is charged to the project as operating expenses. By the second one, 6 people (technicians, editors) have been appointed to operate the system. Final IRR is –14,09% and-15,87% respectively, thus meaning that operating expenses have little influence upon final result.

100% of capital distributed over two years; change of operating expenses
Operating expenses have been allowed to vary within the same range as above, but this time investment were separated into 2 years: 350400 US$ at year zero, 210000 US$ at year 1. Relevant IRR becomes –13,64% when 2 people are charged of operation and –15,46% when operating people turns into 6 units. This is the evidence that even this hypothesis does not affect very much final result.

Change in the revenue variable
A further check was made using the IRR model, to understand the effect of revenues (economies) over the whole economic process. Under the original structure of problem (investment at year zero; operating expenses corresponding to salary of 4 people) economies were assume to vary. Significant the effect: whether economies raise by 20% the final IRR improves by 2,85 points per cent (-12,13% vs –14,98%); in case economies raise by 40% the improvement is of 5,68 (-9,30% vs –14,98%). Particular interest may take the value of variable revenue which exactly compensates the expenses of the project (IRR = 0): the increase in the economies should be of 120% in this case.

These and other information, as to explore alternative conditions to implement a project, may come to management by using the IRR model which keeps its validity.
Important to remember that projects as the one analysed in this paper are conceived to have a cultural impact either in the research and in the work activities; it is not a business and, consequently, it is not expected to produce revenue at all. Rather the project produces economies to School and significant advantage to Teachers and Administrative people: their “time saving” turns to students who, besides an easier access to information, get better relationship with Teachers and Administrative people.