

# **A CASE STUDY IN CAMEROON**

## **EXTENSION OF WIRELESS NETWORK IN CAMPUS OF DOUALA UNIVERSITY**

The project was introduced at ICTP in Trieste by **Dr Mabo Tadjio Elie Martial** who is part of technical Committee of the Douala University and actively participate in global technique network management of the University. The project is divided into three phases. The first phase will be devoted to the acquisition of necessary material. The second phase will concern the installation and the test of the WLAN network and the last phase will consist in training two network administrators for the management of these equipment.

The project has the goal of interconnecting the following structures to the Main Building of Douala University, so that they can benefit from the advantages offered by the existing Local Area Network (Files sharing, application management access, web access, synchronous and asynchronous communication):

1. Faculty of economic sciences and applied management (FSEGA)
2. Faculty of political and judicial sciences (FLFP)
3. faculty of letters and social sciences (FLSH)
4. The Direction of work (DCOU)
5. Direction of infrastructures, planning & development (DIPD)
6. Direction of Administrative and Financial Affairs (DAF)
7. The Financial Control (CF)
8. The building that accommodates Teachers' office
9. The Medical Social Centre (CMS)
10. Students' House
11. Amphitheatre 1500

The different sites are located on a geographic area relatively flat (visibility) and at a maximum distance from Main Building of 5 km. The wireless network will add up to the wire network already existing. The Douala University is connected to Internet by a leased line that has a bandwidth of 256 K for Up Link and 512 K for Down link.

The project will allow, as well, teachers in the main Campus having a laptop computer to be connected to the Wireless Local Area Network (WLAN) of the University so as to have access to the Internet and do their researches.

Financing of project should be assured by the Douala University: a study carried out by members of the IT Technical Committee about the implementation of master computerisation plan did limit relevant budget at **17,000,000 F** or an approximate total of **31200 US\$**.

### Approach to project feasibility

Economic feasibility of proposed project can be estimated by comparing the cost of additional network and central equipment with the economies (benefits in term of improving distribution of self-teaching programs, 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

As only fragmentary information exist about total cost of system installed, it is assumed that total cost is separated into the following components:

A Central Unit installed in the Main Building of Douala University to serve all the structures that will be connected according to the project.

A wireless network that adds up to the cable network already existing with the same logical configuration. Possibly, Subnets are created with the objective of segmenting the LAN according to level of users (Directorate, Faculties, Students, etc.).

A number of terminal stations (PC) sufficient to cope with estimated demand.

The above scheme is a working base which may serve as a reference for similar estimates.

*Capital cost* – Cost for purchasing a Central Unit and Web hardware and software. In particular, taking figures from current literature and waiting for real information, Central Unit is supposed as 16500 US\$, Web server hardware as 8000 US\$, Web server software as 5900 US\$, Content Creation as 7600 US\$, training cost as 22000, for a total of **60000 US\$**.

20% of capital cost (**12000 US\$**) is added to account for installation.

*Network cost* – Cost of network was indicated when the project was presented. In particular cost for purchasing Base Station, Users' Stations, Accessories is 12846 US \$. Such a cost relates to acquisition of wireless material. Installation and configuration of network accounts for an additional amount of 14682 US \$. The training is worth of 3672 US \$. Total cost for the additional network is, then: **31200 US \$**.

*Operating cost* – WLAN connections are maintained and operated from central node: people involved, as said above, are two. No estimate was discussed during the presentation of project: consequently, if an average salary is assumed of 150 US\$/month/employee, relevant annual expenses are estimated at **3600 US \$/year** (2x150x12).

*Individual cost* – unit cost of new PC together with relevant facilities (e-mail, training, database access) is **1200 US\$/PC**. Again, as no mention was made about the number of new PC to operate, the gross hypothesis is made that 20 new PC will be working per each site: if this is the case, relevant total cost is **240000 US \$** (=200x1200).

### Estimate and quantification of benefits

According to the project, the recipients of benefits are some Faculties (economic, political, letters, social), some Directions (work, planning, administrative, financial) other than the Teachers' Offices, the Medical Social Centre, the Amphitheatre.

The recipients of project belonging to School Sector are, mainly: Teachers, Administrative Staff, Students. An estimate of working time per category is given, in detail, in **Annex 1**. It concerns the only activity relevant to duties excluding self-training, Congress, Seminars, etc.

The benefits coming to School and to people therein working are as follows:

1. the School save money as Teachers, Staff and Students have less recourse to the so-called "intermediate consumption" (telephone, fax, courier, photocopies). **Annex 2** shows the situation before and after the implementation of the project.
2. Recourse to Library is justified by the need of getting information, of self-training, of updating files etc. **Annex 3** describes the benefit coming back to all categories of users. Total requests arriving per day were estimated as **48** 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 the advantages coming to Teachers and Administrative people who can improve their working efficiency.

### 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) for which access to Intranet turns to be the appropriate support to short down working processes.

The assumed salary is **300 US\$/month**; the cost per hour is **5,11 US\$/hour** ( $=300 \times 12 / 704$ )

*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 for **46,08 US\$/year** per Teacher (**Annex 2**): it corresponds to **1,28 %** of annual salary ( $=46,08/300/12$ ). Total saving coming to School is proportionate to total Teachers involved.

*Queuing at Library* - the project lets Teachers save 1,80 ( $=60 \times (0,13 - 0,10)$ ) minutes for queuing (**Annex 3**). On a year basis, it becomes **34,56 hours/year** ( $=1,8 \times 6 \times 6 \times 4 \times 8 / 60$ ) and corresponds to an increase of efficiency of **4,91 %** ( $=34,56/704$ ). In monetary terms Teachers would save **176 US\$/year** ( $34,56 \times 5,11$ ): total saving coming to School is proportionate to total number of Teachers involved.

As well, the idleness of two librarians increase from 0,67 to 0,74 per hour; it corresponds to a saving of 4,2 minutes per hour of duty or, on a year basis, of **84,0 hours/year** and per librarian ( $=4,2 \times 6 \times 5 \times 4 \times 10 / 60$ ). Theoretically (salary per month = 150, cost per hour = 1,49 US\$/hour ( $=150 \times 12 / 1208$ )), the unit saving is **125,17 US\$/year** per librarian.

*Producing documents* – It is supposed that, under paper-based process, 1,20 documents arrive in the reference hour (derived from Annex 2) to one Teacher and that 1,56 documents may be completed in the same time (**Annex 4**). During the period dedicated to this activity, Teachers are engaged at more than 70% of their working time. Under automatic procedures, Teachers can perform the same actions in less time: their idleness moves from 0,23 to 0,27. That means a saving of 2,4 minutes per hour ( $46,08 \text{ hours/year} = 2,4 \times 6 \times 6 \times 4 \times 8 / 60$ ) which corresponds to an efficiency of **6,55 %** ( $= 46,08 / 704$ ). In monetary terms, the saving is **235,47 \$/year** ( $= 46,08 \times 5,11$ ) per Teacher: total saving is proportionate to total 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 (Intranet) 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 **6,72 US\$** per year and per Student. Total benefit is proportionate to number of Students.

*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 **1,80 minutes per day** ( $= (0,13 - 0,10) \times 60$ ), that is **34,56 hours per year** ( $= 1,80 \times 6 \times 6 \times 4 \times 8 / 60$ ) which corresponds to a saving of time in the working activity of Students of **3,53%** ( $= 34,56 / 980$ ).

### **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.

The assumed salary is **150 US\$/month**; the cost per hour is **1,49US\$/hour** ( $= 150 \times 12 / 1208$ )

*Intermediate consumption* – unit benefit for reduction of intermediate consumption (**Annex 2**) is **62,4 US \$** per year and corresponds to **3,47%** ( $= 62,4 / 150 / 12$ ) 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 shows that, moving from paper-based to automatic process, number of Administrative people idle increases from 0,28 to 0,32; that is 2,4 minutes per hour. The figure turns into **57,60 hour/year** ( $= 2,4 \times 6 \times 5 \times 4 \times 10 / 60$ ) per people with an efficiency of **4.77%** ( $= 57,60 / 1208$ ). Corresponding saving is **85,82 US\$/year** ( $= 57,6 \times 1,49$ ) per people. Total benefit is proportionate to total Administrative staff involved.

### **Conclusions**

Feasibility of project is, as an example, calculated in **Annex 6**.

The following working hypothesis are made:

- A new Central Unit is installed in the main building of Douala University;
- Ten of previously listed sites are connected to Central Unit;
- 200 new PC are purchased to complete serving final users;
- Final users are: 300 Teachers, 1500 Students, 200 Administrative Staff.

Investment derive from current experience and from the cost shown in the project; operating expenses are proportionate to the cost of two dedicated people; revenue are assumed as the sum total of benefits earned by the Schools (reducing intermediate consumption).

Under these input conditions, the IRR model produces a return of  $-14,23\%$ : the negative sign means that total economies, as quantified above, are not sufficient to cover total expenses incurred in the project. Such final result is expected for non profit Organisation like University so that even if, after turning working hypothesis into real data, the IRR keeps negative it does not necessarily mean that the project must be given up. From economic point of view, the project provides internal economies that let recover part of the expenses of the project; in general either Teachers and Administrative Staff they recovered efficiency in their work; the time saving by Teachers can turn into a better assistance to Students; the labour saved either by Teachers and Administrative Staff lets optimise, if necessary, the personnel by categories.

Rather, the model can be used, especially during the planning phase, to evaluate some aspects of the project, to check the most economic implementation of its structure, to help decisions. As an example, some alternative scenarios have been explored with following results.

*100% of capital concentrated at year zero, no operating expenses*

All investment are concentrated at year zero, no extra expense is necessary for operation of system as it is supposed to be included in the general operating expenses of University, benefits are only those relevant to intermediate consumption. The resulting IRR is:  $-12,78\%$ .

The improvement is only  $1,45\%$  with respect to the basic final IRR ( $14,23\%$ ) and cannot be considered very much significant.

*100% of capital concentrated at year zero, 6 operating people*

All investment are concentrated at year zero, operation of system is entrusted to six people dedicated to run and manage the system benefits are only those relevant to intermediate consumption. The resulting IRR is:  $-17,15\%$ . Final result deteriorates by  $2,92\%$ . Still, the final result it is not either discouraging nor very significant.

*100% of capital distributed over two years (0 and 1), no operating expenses*

Investment are distributed within the first two years (year 0: 223200; Year 1: 120000), no extra expense is necessary for operation of system as it is supposed to be included in the general operating expenses of University, benefits are only those relevant to intermediate consumption. The resulting IRR is:  $-12,33\%$ . Final result does not deteriorate with respect to the original  $-12,78\%$  thus indicating that the decision does not drive to any improvement. Similar re-

sults are obtained in case of 2 or 6 people charged of operating the system (-13,82% and -16,78% respectively).

*100% of capital at year zero, 2 operating people, benefits increase by 20% and 40%*

Under the standard case of investment concentrated at year zero and operating expenses corresponding to the salary of 2 people in charge, benefits were allowed to increase by 20% and 40%. The final effects are: in the first case the IRR becomes -11,30%, in the second one it is -8,39%. Any "spontaneous" or "guided" move to increase the saving of intermediate consumption produces, as it was expected, an improvement into the feasibility (respectively: 2,93% and 5,84%) of project. To be consistent with the logic of the analysis, the IRR becomes close to zero (a satisfactory +0,21%) when benefits increase by 100% (72250 US\$/year).

The above examples should provide the perception of flexibility of IRR model and of its possible applications either when planning the introduction of Intranet/Extranet systems or when studying their impact. Whether input variables are re-interpreted and final results obtained are correctly recognised, the model is undoubtedly valid.