Millennium Challenges for Academic Networking in Albania

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Abstract—**This paper is a case study of networking in Albania. Introduction of computer based ICT in Albania was done relatively early. At the same time certain aspects of ICT usage were neglected by the same policy that promoted it. Use of computers before nineties was mainly for solving technical problems and statistical data processing. In such environment the first network was built and used mainly for remote data processing. Not used for data exchange, this network was doomed by personal computers in nineties. Its lessons may help to understand better alternatives of the present in developing countries. Implementation and deployment of ICT in nineties started from beginning. Following the road of other countries was considered easy, thought installation of PCs and latter of local networks and even Internet connectivity. But important questions emerged showing the complexity of development processes: how networks will be built, used and funded. The impact of ICT in public sectors depends on the content, and the latter depends on human relations and institutional building processes. Shaping traditional roads of implementation and deployment ICT to match particularities of each country is crucial for the future. Particular dilemmas have to do with the academic community and the academic network. The role of this community has disputable issues due to particular situation of a developing country in transition towards a global society. Such particularities are mixed up with development policies and imported work practices, conditioning implementation and maintenance of ICT in academic sectors, as it is in other public sectors as well. The success of transition processes depends on how these incompatible elements will be matched together**

Index Terms--**Academic Network, Developing Countries, Implementation of ICT, ICT in Public Sector.**

I. Introduction

Albania is characterized by particular ways of development during last decades, development that often had quite contradictory trends. Deployment of ICT was an example where progress and backwardness were blended together. Computing in Albania was introduced in 1971 with the creation of Center of Mathematical Calculus (started as university department and latter went under the Academy of Sciences). In that time it was result of a political decision to introduce new computing technologies, which would be used to solve many technical problems in the framework of self-reliance principle state was applying strongly.

For about 20 years main applications had an academic character as mathematical modeling for research, engineering calculations and statistical data processing. All applications were from considered as important fields of economy as geology and mining, energy, constructions, agriculture etc. Some training practices were done for students as well.

The idea of using computers was extended more during seventies, with 4 other centers of calculus created in Albania. Other than Center of Mathematical Calculus there were Calculus Center for Oil and Gas Research, Calculus Center of Topography, Military Calculus Center, and Center of Economical Evidences. The technology was transistors and few simple integrated circuits, using perforated media for data entry and simple printing devices for output.

The firsts step in the road leading towards the information society were done. This road proved to be very rough and going in circles...

II. Seventies - the Roots of ICT Development

Profile of Calculus Centers created in seventies reflects the real policy applied by the state. Center of Mathematical Calculus used to cover problems from different domains that state was interested. Meanwhile oil and gas prospecting was one of key branches of Albanian economy and the attention of state on it was enormous both in investments and political attention, all this reflected with the creation of a special center for seismic data processing. On the other hand, military activities were considered as crucial for the security and survival of the country, which was reflected with the creation of two specialized calculation centers. Results obtained by the one dedicated on topography would also support geologic and construction works carried out in Albania. At last, the need for strong hand controlling of finances of enterprises pushed the state to build a specialized center for helping accounting.

Banks were little involved with these calculation activities. While strongly controlling the finances of enterprises following rigid laws, banks were in a much more strong and closed control while their activities were minimal as result of total missing of private activities. While in other countries banks were one of main clients for computation technologies and pushers for their development, in Albania banks had no role at all.

Manuscript received November 5, 2002.

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Beside banks, telecommunications were also "neglected" and minimal investments were done only to assure limited basic telephony services that would be in total control of state. All this had grave consequences for future developments of ICT.

Technology of computers gradually became old due to lack of continuous investments. State did not understood rapid steps of technological progress in developed world, following the way of exploiting at maximum human resources while spending little money for technological renewal. Perforated cards and tapes were used for more that 15 years while the world had them forgotten. This was one characteristic of development that still continues to be present in new forms of neglecting funds for maintenance and renewal..

The other characteristic was lack of collaborative work between different calculus centers between themselves and with other institutions. While Center of Mathematical Calculus was forced to collaborate with other institutions, other centers had so closed working profile that little communicated with outside. As result no interconnection between all these centers was established. Other research and development institutions were in similar situation - due to strict state planing of everything, concurrency was forbidden concept and all institutes had some monopolistic position.

The lack of redundancy would not stimulate important exchanges of data and interconnection of computing facilities. Moreover, during seventies the political regime followed a policy of going gradually towards isolation and international collaboration was forbidden. As result, there was no data interchange with abroad and this canceled the last motive for implementing new telecommunication infrastructure and deploying any data exchange facilities.

The paradox of this situation was that, despite problems and difficulties, a number of mathematicians and specialists from other domains continued to use old computers increasing the range of applications and creating conditions for new developments. There were important technical applications in energetic, geology, civil engineering, statistics etc. Even the civic registration was carried out at the end of seventies using perforated tapes. In a time when state liked to talk about science, all this represented a good argument.

III. Eighties - Blooming of "Informatics" and Networking

Beginning of eighties found the country almost completely isolated, without any important international partner. Self-reliance became the main political issue, and as result particular attention was shown for improving engineering works and management of economy. The latter one was paradoxical, because the economy was controlled by political factors first of all, leaving no place for other arguments. Formally the attention was in place, together with good and real arguments about usefulness of computer technologies.

Other arguments came from specialists who though few communications with external world had understood the leap towards new technologies and networking, and they started to make pressure from bottom for implementing new ICT. All this was blended together to give shape a project supported by UNDP. This time it was not simply for applied mathematical methods, but for "informatics" first of all. That was a two-fold idea. In one hand, it was proposed for an overall increasing of solutions for already "computerized" technical domains through using more complex methods and algorithms. In the other hand, it was proposed to attack for the first time economical and managerial problems through processing, combining and interchanging different sets of data through a metropolitan network, connecting different ministries and main academic institutions, and building complex databases to support good and objective decision making.

The idea for a quite new ICT infrastructure was pretty compatible with theoretical principles promoted by state. Nevertheless, it was the time when first personal computers had emerged, and it opened many discussions between different specialists about the way to be followed. Government took final decision for a star-topology network based on mainframes, instead of isolated low capacity existent PCs. We may suppose that government was more interested to extend production of computer solutions based on 10 years of experience and tradition instead of experimenting with personal computers - a centralized network fitted perfectly with the organization and needs of the state itself. Moreover, in beginning of eighties mainframes were not declined yet while OSI networking standards were considered as the future of telecommunication. Ironically, some distinguished literature of mid-eighties considered TCP/IP as "old and outdated protocol".

The project was completed in 1985. It was a blending of academic and government network. Connected sites were main academic institutions and ministries. The idea was to extend computer and mathematical applications in public administration affairs. For this purpose application packages were installed, including database management systems and Cobol extensions for developing transactional applications over network. Special training was carried out for specialists, programmers and system engineers. All necessary technical conditions were prepared for development of networking applications. ([5], [6], [7])

For some reasons the network was used very little for useful digital data storage and exchange. Connected ministries used it very little, while used successfully for remote calculations following the old trends established during seventies. It was used for research and technical problems; old and new mathematical modeling and statistical calculations were further developed using new mainframes. One negative factor for this partial failure of network was missing necessary institution building to provide such information systems that would be formalized and programmed without being influenced directly by the politics and decision making. Technical problems had much more independence from politics and they were processed mainly through individual work (Fig. 1). Data

processing and exchange in public administration would require institutionally collaborative work and was strongly influenced by politics (Fig. 2). Big projects were launched but not favored for completion while small randomly developed applications could not create the necessary critical mass to impact the functioning of ministries.

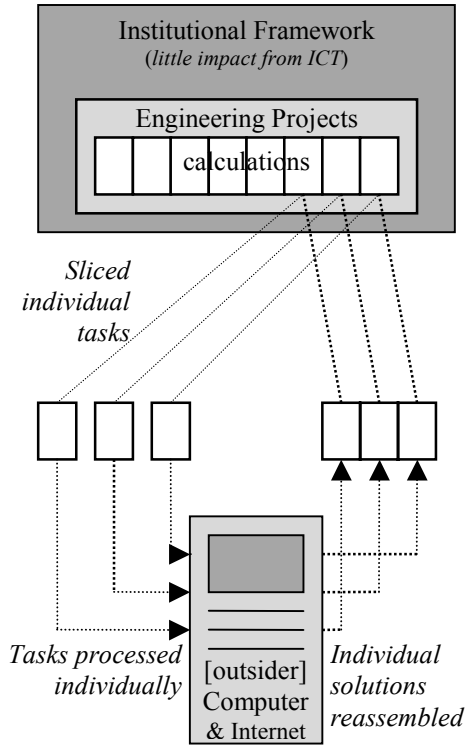

Fig. 1. Engineering problems include considerable calculations where use of ICT may be "external" having little impact on institutional frameworks

The example of documentary database created during late eighties clarifies another negative factor. Its creation was motivated considering theoretical need of country to have access to huge collection of technical documents, projects, books and journals distributed in many libraries and archives of different institutions. Considered simply from a political view, it would be useful while the reality was different. There were two problems. First, it was that Albania has a small academic community concentrated in Tirana, and majority of documents necessary for technical works was easily reachable. Second, in connected institutions there was normally a single ASCII terminal, and for many specialists it was not easy to have access on it. As result, the database was not attractive for its potential users.

There was little overlapping between working fields of different institutions, and there were no free international exchanges at all. Only some experiments were successfully carried out to test possibilities of using high voltage inter-city power lines to extend the network in other main cities, while telecommunication infrastructure was so undeveloped that could not offer any leased line at all ([14]). As conclusion, main usage of the network was remote data processing. When new user-friendly PCs began to enter in the country, people was more attracted by them than with ASCII terminals connected to the network. The network was condemned - partially abandoned by users and without financial resources to keep it running it was closed down. ([3], [11])

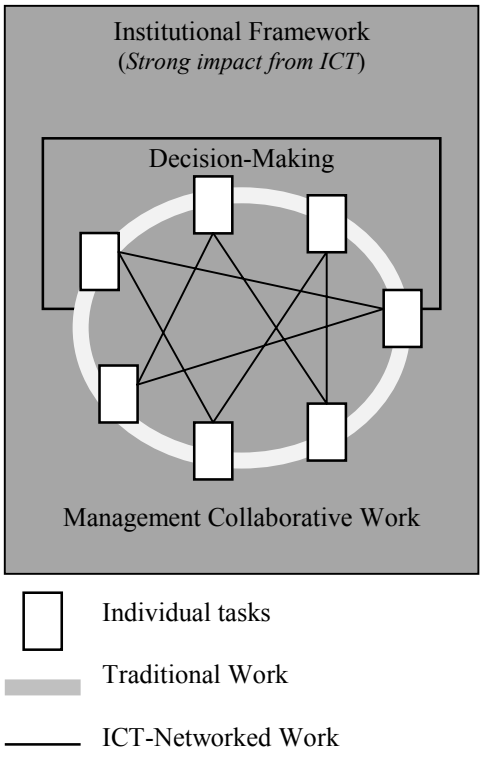

Fig. 2. Management problems include considerable collaborative work, where use of ICT may impact strongly institutional frameworks and human relations.

IV. Nineties - Decline and Renaissance

Beginning of nineties was characterized by collapse of old centralized state structures that used the metropolitan network. New structures emerged creating a decentralized environment where public administration, autonomous education and research institutions, private and public enterprises, NGOs and international organizations were mixed. Country was opened and liberalized marked was invaded by Personal Computers with better performances than old mainframes. The network, used only for remote data processing was abandoned gradually, while it was more and more financially difficult to keep it running. In 1993 the network was closed down.

Mid-nineties were characterized by the "renaissance" of ICT. First, many organizations began to use new PCs in their daily works. While before computers were seem more as a tool of research and engineering, now they literally invaded offices in a top-down way, central offices in Tirana having more possibilities to profit from different projects and donations.

Specialized research and education institutions of the Academy of Sciences of Albania and in Universities of Tirana started with experimenting new local network technologies, Ethernet and TCP/IP. The first dial-up international link was established by Department of Informatics of Tirana University with EARN node in CNR, Pisa Italy; also ccTld AL was

registered, but the connection lasted only some months due to technical problems of telecommunication infrastructure. It was finally re-established (always as dial-up) by Institute of Informatics and Applied Mathematics (INIMA) in 1994 in the framework of a Copernicus project.

Albanian telecommunication operator began improving its infrastructure, installing digital switches and optical fiber links within Tirana, with big cities and also neighbor countries. Quality of telecommunication improved considerably facilitating dial-up connections, but the operator was not able yet to offer leased lines. The same handicap happened with mobile operators newly established, which were not able to offer data transmission services. During the end of nineties emerging all Internet Providers were forced to use satellite links to connect with the Internet.

Nineties were turbulent but exciting years. Attempts to solve in sustainable way the Internet connectivity continued for years in separated initiatives with little collaboration between each other and without any financial support. Government entities involved with telecommunication issues were pushed from bottom to undertake any action to improve networking; but their attitude was generally negative and only at the end of nineties legislation was liberalized to open way for free concurrency in data transmission. Albania participated also in a regional PHARE project for development of academic information network. This project was manipulated by former Committee of Science and Technology that charged non-competent institutions to deal with it; and it was sabotaged by telecommunication monopolistic circles that were not able to implement Internet services by themselves. The project was finally doomed during the revolt of 1997.

Lack of funding to cover running costs made any local initiative unrealizable. It is not a surprise that first Internet services were non-for-profit for public and non-governmental organizations, created by UNDP (email service, 1996) and Soros Foundation - OSFA (Internet service, 1997). Open Internet Center (OiC) created by OSFA connected several academic institutions using wireless Ethernet technology, supported also by INIMA and Department of Electronics of Polytechnic University, and creating a small academic network. Government used it as well, but it did not considered any attention for the academic network. New Millennium marked the termination of Internet project of UNDP and OSFA, and the academic community remained without any network as it happened ten years ago. Actually academic institutions have limited dial-up access through private ISPs, with few exceptions that use low capacity leased lines; while responsible structures created by Ministry of Education and Science in collaboration with Academy of Sciences of Albania are considering to realize a new project sponsored by Italian government to recreate the academic network.

V. Millennium Challenges for the Academic Network

Building an academic network in Albania means, first of all, a metropolitan network in Tirana where academic institutions are dispersed in different parts of the city. Second, inter-city links are necessary to connect universities in other cities. Third, there is the problem of international links in three levels: regional, European and worldwide.

Problems have to do with investments in infrastructure, involvement of human resources, and running costs of leased lines. ([1], [13], [15], [16], [20])

For a network to survive it needs to offer services to its users; services that users really require, not services that may be required. Design of scaleable networks permits running of services in conditions of variable resources. In conditions of developing countries, the principal service to be offered and intensively used would be the international connectivity. People must have access to this network in a direct way. The impact of a single workstation connected to a broadband network would be negligible compared with slow dial-up connection that may be available for many workstations. International connectivity may be exploited individually and is useful in any situation, despite the level of research and education. The process is similar with what is presented in Fig. 1.

At the same time content production over the network is the key to acquire continuous funding to cover running costs of the network. Useful content production is result of collaborative work within the country and internationally as well, considering the process presented in Fig. 2. Collaborative work requires motivating conditions and resources (especially funding) that may be missing or differently oriented in developing countries. Government and international institutions may play a considerable role to improve motivating conditions pushing the academic community for collaborative work and content production.

These issues are discussed within country and in regional level as well. Possible funding resources are identified; (a) aids from Italian and other foreign governments; (b) national programme for research and development with its limited budget; (c) EC programmes and NATO network infrastructure projects; and (d) other donors to be found. In regional level there were three initiatives of: (i) UNESCO-ROSTE, following the initiative taken at the Meeting of Venice in 2001 for stimulation of research in South-Eastern Europe; (ii) Max Plank Institute for Theoretical Physics, as extension of the project SIN-YU for the academic network in Serbia; and (iii) EC project SEEREN, leaded by Greek Academic Network GRNet for establishing regional links to a nearby GEANT node.

Financial and technical issues were discussed in a number of international meeting, suggesting following principle: “built private broadband networks to reduce running telecommunication costs.” Motivation of this principle was due to relatively high telecommunication costs in SEE, compared with the financial resources of respective academic networks. Adequate funding would require particular political will from government and considerable content production that would need time to evolve. Evaluating the situation in Albania,

where funding for research is small and not given in regular periodic way, scaleable networking solutions are necessary. A solution would be to assure minimal guaranteed funding from government, while use different projects for increasing local and international bandwidths.

The other crucial issue considered is production of content as a justification of expenses for building and maintaining the network. This well-known issue takes a special value for academic countries of the region - it is strongly connected with the low intensity of research carried out in some of SEE countries. In this context, it would be very important for all actors involved on networking in SEE countries to consider development of academic networks as integral part of research development in general and of integration of research activities in regional and European scale. It means, first of all, motivation of the academic community to be involved directly with networking and do not follow blindly trends of outsourcing.

Increase of research activities based on networking requires not simply motivated individuals, but synergy within the community and involvement of decision-makers. Seen from this point of view, imported funding and solutions are very attractive but dangerous, making people used with free services and liberate administrations from taking care of networking issues. The optimal would be a mixed approach where synergy within academic community - users, ICT specialists and decision-makers is partially supported by foreign donors.

Sustainability of the academic network, created even following the best approach, is dependent from sustainability of academic community itself, that is the ability to produce really useful content and services for both the country and foreign entities, and assure even a minimal budget for running costs. International connectivity for Internet access would be the first service required by academic community, it need to be considered as a temporary transition stage towards entering into regional and European research integration processes. ([2], [4], [8], [9], [22])

Networking means content and collaboration, in simple word coordination of actions and collaboration with other organizations of the same profile, especially those with financial resources. Lack of coordination and collaboration spirit seems to be typical phenomenon in many cases, but it may lead to continuous modification of project goals and even project failures. Collaboration implies means not only useful content production but also a careful balancing between different deployment alternatives, taking into account that there will be the end-users who will decide what are required services and alternatives of their implementation. Collaboration for networking requires good-for-networking partners.

Collaboration and networking implies active and positively oriented involvement of decision making. There is a mentality in developing countries of putting computers first at the administration and latter (if) in laboratories. I this context it is crucial attracting decision-makers to show attention on laboratories instead of administration. It again implies useful content for decision making, as an important component of networking activities.

At last but not the least, building and running effectively an academic network requires motivated human resources. It is a crucial issue for two reasons: brain drainage phenomenon in developing countries, especially for ICT specialists; and non-optimal distribution of financial resources, putting much attention to infrastructure and less in human resources for running services and producing digital content.

VI. Conclusion

It is difficult to speak for the future. The question "*would we be able to follow up the development of ICT*?" remains crucial for developing countries ([10], [12]). Many talks are done about the "leapfrog" concept, but the reality seems to be much more complex and unfriendly. Literature is full of case studies and models categorized as successes or failures. The reality of each country is specific and application of successfully elsewhere models leaves uncovered areas that become originators of failures. Developing specific solutions while considering the external experiences to avoid known errors remains the only solution

Society today is transforming in "information society" that is a kind of "technological society". In this context, research & education are an important set of tools of development and integration. Academic networks serving as inter-institutional laboratories have a particular place in this set of tools. They are at the same time a special indicator of how the society is developed and emancipated. The challenge of Albania for sustainable development and European integration would be reflected on how the academic network will be reconstructed and integrated within the academic community.

The academic system in Albania is suffering consequences of transition. Before the aggressively of free market, it is destined to crawl behind the private and non-governmental sectors until we would be able to push it in the front and transform it in active actor for sustainable development. Prerequisite for this purpose is consolidation of synergy within the academic community. The academic network is a tool to achieve this synergy.

How the academic network evolves reflects how academic community is active in research and how it contributes with the development of the country ([17], [18], [20], [21]). The challenge would be to match positive experiences from developed world with negative conditions of developing country, without creating any explosion but "soft energy" for collaborative work. The challenge would be to attract decision makers to accept that even academic networking may appear a pure luxury compared with other needs of the country. While direct need of academic community is international connectivity for acquiring information and establishing contacts, it is government that may push this community towards collaborative work and content production necessary

for sustainable development of the country.

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