M and Kernel as Appropriate Technology in Health Care in Africa

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Abstract

A hospital information system based on M Technology and VA software has been in operation in a university teaching hospital in Nigeria since January 1991. This paper reviews the experiences and future plans of the Joint Project behind it and the appropriateness of the technology assessed. We regard M and Kernel as highly suitable to multi-user systems in Africa, despite some problems. The need for international cooperation is emphasized.

Introduction: The need for health informatics in Africa

The economic downturn in many developing countries, particularly Africa, has profound effects on healthcare delivery systems. In Nigeria, whose population of roughly 100 million is a fifth of Sub-Saharan Africa, a government policy paper noted a decade ago that only 35% of the population had access to modern health care services, one of every 12 children born alive died before the first birthday, and preventable parasitic diseases were widespread (Nigeria Ministry of Health 1988).

Since the early 1980s, Nigeria has fallen from a "middle income developing country" to a "low income" category, and the few successes of the past years in health care delivery are now being threatened. The socioeconomic crises have severely affected national and international efforts to reduce the high morbidity and mortality rates in the country. As a result, there has been a decline in living standards and an increase in poverty, malnutrition, ill health, and death.

While the need for health care has increased, resources have decreased. Particularly in the rural areas, health care facilities are understaffed, and the remaining personnel work under high pressure. The lack of relevant and timely information, both clinical and planning oriented, means that even existing resources are not always effectively utilized and focused on priority problems. Health informatics, or the use of computers and communications technology in healthcare, can potentially contribute to alleviating the issues of a chronic shortage of qualified and experienced health personnel, low productivity of health care services, and unfocused management. In Africa, microcomputers are indeed widely used in business, but in health care, the technological solutions used in industrialized countries are usually not affordable and feasible, nor do they address the priority needs of the developing countries (Agbalajobi 1983). Local development and adaptation are a necessity.

The Ife Project

A Joint Project on Health Informatics, or the Ife Project, was established in 1989 between the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC) and the Department of Computer Science and Engineering (CSCE) of the Obafemi Awolowo University (OAU), both in Ile-Ife, Nigeria, as well as the Computing Centre of the University of Kuopio, Finland. The aim of the project was to study the feasibility of health informatics in Nigeria in a pilot case.

With about 12,000 students, the OAU is one of the biggest of the thirty universities in Nigeria. The university offers courses in a wide range of disciplines including computer science, medicine, nursing, and pharmacy. The OAUTHC is comprised of two hospital units in two nearby towns with 342 and 212 beds respectively (for secondary and tertiary care), two urban and one rural health centre (for primary care), a dental hospital,

together with schools of nursing, laboratory technology, and medical records.

The medical records department is responsible for health information collection, processing, and delivery, (e.g. the production of daily bed statistics to the management as well as monthly/annual diagnostic (ICD-9) statistics to the Federal Ministry of Health). The medical records staff also have to attend to various requests by resident doctors for research purposes. Although the records procedures are well organized, these are not easy tasks by manual means, with over 100,000 patient folders in the case note library. Over the years, hospital management sought ways of making information processing more effective and decided in 1988 to "go computer."

The University of Kuopio had experience with M and the U.S. Department of Veterans Affairs' (VA) FileMan/Kernel software and obtained a sample of the public domain VA application packages for the Joint Project for demonstration purposes. The project committee studied stand-alone PCs, LANs, and traditional minicomputer configurations as alternative technologies, but all these seemed to be twice as expensive as the M-based alternative, or not suitable for multi-user purposes (Korpela 1992). The availability of VA application packages in the public domain was an extra benefit. Thus the project committee decided to build a prototype on the M/FileMan/Kernel technology.

The first phase of the project focused on the in-patient activities of the Ife State Hospital (ISH) unit. Since January 1991, a rudimentary hospital information system has been in operation at the ISH (Makanjuola et al. 1991). The data entry functions include patient registration, admission, transfer and discharge, as well as the discharge summary (diagnosis code, etc.). The data retrieval functions include patient inquiry, daily bed status, monthly diagnostic statistics, and list of patients on ward.

The system runs on a single 486 Personal (sic!) Computer with three dumb terminals attached to it. The Admission-Discharge-Transfer package of the VA was used as a basis. The bulk of the functionality and patient data fields of the ADT package were dropped, the rest partly modified according to local requirements, and some new functionality added. It was not difficult for the medical records staff to adapt to the new system, since they participated in designing it and the concepts and forms were the same ones, except for the medium.

Since 1992, the project team has organized national workshops to disseminate the knowledge acquired. The partner institutions even organized the First International Working Conference on Health Informatics in Africa (HELINA 93, 19-23 April 1993), in which more than half of all African countries were represented (Mandil et al. eds. 1993). This resulted in not only the other teaching hospitals but the Federal Ministry of Health showing a keen interest in the technology.

Experiences in Using M and Kernel

The VA originally developed its software in the U.S. for large VAX environments running Digital Standard MUMPS (DSM). However, we had no major problems in downscaling it to the 286 PC used for system development running the DataTree implementation of M by InterSystems. This is a very strong indication of the portability of the technology. The Finnish partner localized the FileMan and Kernel software to Nigerian requirements (e.g. to the British date format) and has installed new versions regularly. Versions 20 NG (Nigeria) and 7.1 NG are currently in use, respectively.

FileMan and Kernel are actually a set of high-level systems development tools available almost free of charge. The ad hoc report generation tools have been much needed, although not quite straightforward. Menu management, security management, and auditing facilities are also useful, particularly as the existing M application routines are quite difficult to understand and modify, and there is a high threshold to start programming in M. FileMan and Kernel provide for rapid prototyping and system development without low-level coding to some extent.

The ADT package was not that easily adapted. Pieces of information such as the social security number and veteran classification had to be removed and new ones such as the local government area and ethnicity added to the patient registration function. It was often difficult to understand what functions like "1010 form" or "PTF file" stood for and whether they were relevant to the OAUTHC. Approximately 10% of the original functionality was retained for use.

The changes and additions were made in a controlled manner to facilitate the introduction of new versions of the VA software without disrupting use of the locally developed parts. Nothing was removed from the data dictionary, and existing routines were not touched. If

routines had to be modified, new copies were created with names starting with "NR" (for Nigerian Medical Records). Similarly, all new fields were stored in "NRxxx" global nodes, and all new file and field numbers were in the range 41000- 41999.

The ADT package OAUTHC dates back to 1988. The VA has since replaced ADT with the Patient Information Management System (PIMS) module. PIMS is a prerequisite for some other VA packages (e.g. for Pharmacy and Laboratories which could serve as prototypes for new locally adapted subsystems). Despite the precaution in modifying the ADT software and the regular upgrading of the FileMan/Kernel, we have thus far not taken up the task of upgrading from ADT to PIMS. We anticipate that it will be a major task to track down the changes and find out which ones need to be implemented in the NR package.

The MailMan software of the Kernel has been a very important bonus. The telephone system in Nigeria is extremely overloaded, and ordinary mail is too slow and unreliable for interactive problem solving between the Nigerian and Finnish project personnel in times of urgency. In 1992, the OAUTHC system was connected to a telephone line and modem, and a PC in Finland running MailMan called the OAUTHC MailMan during evening hours. This marked an enormous improvement in communications within the project and many times was the only feasible means of communication.

The importance of email has been graphically pointed out when a phone line, modem or software failure has stopped it—without email, it has taken a long time to jointly troubleshoot the problem! Recently the TCP/IP support of the new MailMan and DataTree M versions made it possible to connect the Finnish end of the OAUTHC-Kuopio link to the Internet, thereby providing the Nigerian team with global email access.

Some modifications to MailMan were necessary, (e.g. to use the Internet standard "First.Lastname@ish.oauthc.edu.ng" format in the email addresses). OAUTHC was the first Internet domain to become operational under the ".ng" country code, although other redirected links via other country codes had worked earlier.

The experience of the Ife Project clearly shows that M and FileMan/Kernel are a highly appropriate technology in Africa because they are scalable from a single standalone PC through robust terminal networks to high-performance client/server networks. No other technology can provide an upgradable low-end introduction to multiuser systems at a comparable price (Korpela 1992). It should be noted that a network of dumb terminals is often more sustainable and less vulnerable than a LAN in the infrastructural and physical environment in Africa, particularly when users are scattered in many separate small buildings such as the Ife State Hospital compound.

Although there are many advantages to using M and Kernel, there are some disadvantages as well. M Technology is not widely known in Africa, and programmers need to be trained in-house. FileMan and Kernel are not inherently internationalized, and the "UK English" versions have to be developed within the project. Our colleagues from Francophone African countries are very keen to adopt our successful experience, but face even bigger translation problems. The user interface of the VA software does not meet the expectations of the African user whose experience with computers has usually been gained with text processing on PCs.

Our experiences utilizing the DHCP applications packages of the VA are twofold. It would have been faster to develop an air pilot system from scratch using FileMan and Kernel than modifying the ADT package. On the other hand, the burden of retaining the VA's cumbersome patient file structure has enabled us to potentially benefit from further applications development at the VA. It seems that DHCP packages can and should be used as examples for prototyping in Africa, and the database structures should be conserved where applicable, but the data entry and reporting functionality usually needs to be completely redeveloped according to local requirements.

A more direct linkage with VA personnel both on the FileMan/Kernel side and the applications side, would be highly beneficial to teams using these technologies in Africa. We understand that the systems development teams at the VA currently have neither a responsibility nor the resources for such cooperation, but we wonder if some means and form for the cooperation could be generated in the future.

The Appropriateness and Sustainability of Health Informatics

The Ife Project has proved that health informatics is indeed feasible and sustainable in Africa, and that M and FileMan/Kernel are an affordable and highly appropriate technology for multiuser systems. In the

final account, however, the appropriateness of the technology is determined by its implications to public health. The OAUTHC system is very inexpensive when compared to alternative technologies and when compared to anything used in hospitals in Europe and the U.S. but it is still a major investment for an African hospital. Has it generated sufficient public health improvements to justify the investment?

According to our analysis of the Ife Project, an Admission-Discharge-Transfer system alone does not bring about sufficient clinical benefits. Currently the system still mainly serves administrative purposes which was not our original intention. Expansion to other service areas and new beneficiary groups will be necessary to truly tap the potential of informatics for health improvements, but that has been slowed down by many practical and socioeconomic problems.

Unstable supply of electricity resulting in hardware faults, difficulty in finding reliable hardware maintenance, viruses, etc. created major problems in the beginning. As years have gone by, we have gained experience on how to manage them. Of great importance has been the Finnish-Nigerian cooperation facilitated by MailMan, through which solutions have been found interactively. In the final account, however, the key issue is whether local system development expertise can be accumulated and financial resources generated to sustain the informatics activity in the long run.

Lack of funding has resulted in a relative lack of systems development personnel, which in turn has overloaded the few people available to do project work in the Department of Computer Science and Engineering and prevented major new expansions. More computer personnel have now been employed at OAUTHC and CSCE and a training program established for them.

As Mayuri Odedra notes, for successful transfer or acquisition of information technology in Africa, what is needed is knowledge or know-how about how a particular system works, how to operate, maintain and develop it, and if need arises, how to produce the different components of the system and assemble them (Odedra 1990). In our case, we cannot claim a total knowledge of the technology but while working on the system expansion, we educate ourselves through weekly workshops in which topics are distributed to all with the assistance of our Finnish partner by email.

Future Prospects

In the next phase of the Ife Project we plan to upgrade to the latest version of the VA Patient Information Management System (including outpatient functions), expand to new units of the Teaching Hospitals Complex, and develop functionalities for drug information, pharmacy and laboratories using the respective VA packages as a model.

The main emphasis, however, is on supporting the primary health care level through the information and processing resources of the hospital (Makanjuola et al. 1995). To that end, we regard it imperative to involve the local communities in designing the overall information activities and to use the computer-based system to provide the communities with feedback information about their health problems and services. This is how we think health informatics can really justify itself.

The OAUTHC system is still the only clinical information system in Nigerian hospitals. Our experience in working with the system since 1991 indicates that it can be fairly easily employed nationwide if sufficient resources for systems development can be generated and if the socioeconomic and political situation in the country does not deteriorate.

Our experience will also be disseminated to the wider African audience in the HELINA 96 conference (2nd International Working Conference on Health Informatics in Africa) near Johannesburg, South Africa, 15-17 April 1996.

All this is not possible without considerable strengthening of the health informatics research and development capacities, human and material, of the Department of Computer Science and Engineering, OAU. Therefore the Ife Project combined health informatics teams in five other African and three European countries to form the INDE-HELA (Informatics Development for Health in Africa) consortium to share experiences and search for research and development funding. The consortium submitted an application to the European Union but was asked to reapply next year. We are still lacking financial means for implementing our plans.

Conclusion

The experience of the Ife Project shows that informatics, while not a panacea, has a role to play in improving the clinical and managerial use of information for action in

health care delivery in Africa and thereby a role in public health improvements. The establishment of local systems development and support teams and a gradual accumulation of know-how and expertise by them, is the main prerequisite for sustainability. To that end, persistent work over several years, international cooperation, and sufficient funding are required.

M and FileMan/Kernel have proved a feasible, sustainable and affordable technology even in a dwindling economy. The good news of M and FileMan/Kernel in Africa could be made even stronger by some coordinated efforts in internationalizing the technology and by support from colleagues in other countries. **M**

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