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COMPUTERISED INFORMATION MANAGEMENT IN A SYSTEM-POOR ENVIRONMENT

Lessons from the Design and Implementation of
a Computer System for the Sudanese Planning Ministry

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Information management is a critical problem for development planning. It is an especially difficult issue for those Third World planning ministries which must adapt to the escalating demands for information posed by a proliferation of donors and multilateral agencies. Yet, effective information management is crucial if domestic policy makers are to be able either to plan for or to monitor the performance of externally-funded development projects. Microcomputer-based management information systems are now being implemented in a wide variety of settings to deal with these problems. The present paper reports on the development of such a system in the Sudan. From this case study, lessons are drawn for future management information system implementations in 'system-poor' technical environments and organisational contexts highly dependent on external funding sources.

There is an international mandate for national economic development planning and concomitant maintenance of national accounts. It is implicit in the activities of the World Bank and IMF. Evidence of development planning is sought by both private and public donors, even by the United States which is one of the few countries in the world to lack its own domestic planning agency. Scholars hold up successful cases of planned development as models for other countries, and their words are backed up by the ability of agencies to deliver billions of dollars in aid. But most economists and government officials in the Third World are already convinced of the merits of planning and national accounts, even where they reject the specific proposals of the IMF and other international agencies. They are graduates of the same university programmes as the IMF officials, and they have been trained to believe in development planning.¹ Yet this pursuit of planned development and effective national accounting runs up against severe limits of both political will and bureaucratic capacity.² In particular, serious planning efforts and superficial attempts to meet the requirements of international donors and other agencies both require the management of an enormous range and complexity of information. This paper is about lessons to be learned from an attempt to use microcomputers to help meet the demand for

information management in the Ministry of Finance and Economic Planning of the Sudan.³

Recognising difficulties in managing accounts and monitoring actual performance, both Sudanese officials and expatriate consultants sought more efficient administrative techniques. Attention was focused on a range of problems, but information management appeared central among them. Computer technology presented an appealing approach to this problem for several reasons. First, computers are a prestigious technology. Using them seems a readily justifiable matter of being 'up-to-date'. Second, computers can (at least apparently) be implemented without challenging deeper structural problems in an organisation. Third, computerisation is an important feature of efficient administration in many of the international organisations which both offer advice and provide funding for efforts to improve administrative capacity in Third World countries. Fourth, new microcomputer technology made experimentation with computers financially feasible, not only because of low total cost, but because implementation could proceed in a piecemeal and gradual fashion.

The introduction of computer technology into the Sudanese development planning administration also presented several problems. Since this paper will focus largely on these problems, and on lessons for the implementation process in similar settings, it is necessary at the outset to ask whether it makes sense to introduce computer technology into settings where most of the appropriate skills, physical infrastructure and support systems may be lacking. Some observers clearly think not. Why should the Sudan need computers at this stage of development, they ask, when (in the words of one reader of an earlier version of this paper), 'there were no computers in the United States before the 1950s and the largest economy in human history was organised (planned, monitored and controlled) at both micro and macro levels'? Three considerations suggest that it may be sensible to put microcomputers to use in settings like the Sudan despite the difficulties. First, a contemporary Third World country, especially one which depends heavily on foreign donors and related agencies for its economic well-being, is drawn into a web of record keeping, data provision and paperwork which its domestic economy would not necessitate. This is the result of its external dependency, because the international organisations which provide aid and monitor credit make the provision, manipulation and management of information central. Second, precisely because the Sudan lacks some of the means to accomplish planning and administration through the development of elaborate 'paper and pencil' systems, it may derive advantages from the use of computers. As we shall suggest below, computer implementation may, on occasion, provide for overcoming—or bypassing—ineffective bureaucratic procedures. Moreover, although 'paper and pencil' record-keeping systems are easier to establish, they are much harder to operate on a very large scale. This problem is accentuated where they have not grown gradually and organically to that scale (as was the case in most industrial countries) but are being implemented rapidly and under outside pressure. Both trained manpower and adequate organisational procedures usually take generations to develop.⁴ Of course, a computer-based information system also may run foul of both manpower and administrative

problems. Nonetheless, introducing an elaborate paper-based accounting system may actually require more training and introduce more organisational complexities than accomplishing similar goals with the use of microcomputers. Third, it is of course the case that the United States in the 1950s was precisely an economy which not only generated a need for information management technology, but generated the demand which helped to produce development of that technology. To point out that it could be run without computers is not to argue that computers were not a useful innovation.

In short, there is at least a *prima facie* case for the usefulness of microcomputers for information management in the bureaucracies of even the least 'developed' of the world's countries. In the present paper, we will not concentrate on developing that case.⁵ Nor will we list the various counter-arguments based on the role computers may play in enhancing the centralisation of power in undemocratic regimes. Rather, we will focus on some of the difficulties and complications—both foreseen and unforeseen—which attended our effort to introduce microcomputers into the work of the Ministry of Finance and Economic Planning of the Government of Sudan. It may be possible to refer generally to the issues we raise within one or both of two limits. First, they may apply to any effort to introduce computers where there have previously been none and where similar procedures and other technological innovations have not paved the way. Our Sudanese case study details experience in a relatively inhospitable environment for computing, one where computerisation efforts could not build on strong foundations from prior computer use, on strong support systems, physical infrastructure, technological familiarity, or even a common linguistic basis. Such inhospitable environments may occur in a variety of contexts, though they are particularly likely to face those working in less developed countries. Second, the issues we raise may apply wherever information management tasks are predominantly externally imposed by organisations working under very different constraints from those which will host the systems, and where the ideological definition of tasks may not correspond to real efforts, accomplishments, or even requirements. In other words, some of what we found in our Sudanese implementation effort concerned not general features of computerisation in system-poor environments, but the way in which information management tasks are imposed on and understood by the key actors in the development planning process. Similar conditions may obtain wherever the information systems or bureaucracies in question are part of the curious modern phenomenon of planned development. This requires further brief discussion.

Development Planning and Aid Dependency

The various domestic and international actors who demand development planning (a) may have very little sense of the complexities of data management, (b) may have no intention of doing actual analysis on the data collected, and, therefore, (c) are often mandating not actual planned development but conformity to a myth concerning the role of planning and centralised monitoring.⁶ The demands for development plans, therefore, may even be at their most extreme in

those cases where they are least likely to be effective—the poorest countries of the world.⁷

In the Sudan, during the drought of the early 1980s, foreign aid and related activities accounted for the absolute majority of macro-economic activity; without it, we might reasonably say, there would have been no national level economy but only local subsistence economies. Even in better years of the last decade and a half, formal sector domestic production has been relatively small in comparison to international borrowing and aid. In such a setting, the ideas of centralised planning and monitoring face the realities of seemingly intractable economic problems, the absence of a transportation and communications infrastructure to knit the country together, organisationally weak governments and in many cases severe brain drains. Moreover, the various external actors (USAID and other bilateral donors, the World Bank, UN agencies, etc.) which may call for effective central government nonetheless help in many ways to undermine it. Their agents demand constant attention from senior government officials, distracting the latter from their domestic duties. Each international organisation imposes its own set of rules and procedures and demands information in its own format; too many also shift constantly from one to another currently fashionable strategy for economic development.⁸ The number of donors and the extent of dependence on them have increased dramatically in the last several years through most of sub-Saharan Africa.⁹

The Sudan, a country rich in potential but extremely poor in current accounts, exemplifies these characteristics. There is virtually no planned development in the Sudan, but some 500 people in the Ministry of Finance and Economic Planning and numerous agents of foreign donors all pretend that there is. We were asked to develop a management information system to assist them. Our first question had to be: just what were they doing?

Sudanese national economic planning conforms to Robertson's general characterisation of planning as a social institution: 'Especially among the newer states, national planning has become a political credential, a device for doing business in the international arena as well as the accepted instrument for transforming economy and society within each state'¹⁰ Every organisation and every activity in the Sudanese economy is shaped by the overall pattern of dependence on foreign donors and lenders. A planning ministry in such an economy is fundamentally an organisation which mediates between the government of that country and foreign economic donors and regulators.¹¹ The Sudan has virtually no non-agricultural production, and it is not even self-sufficient in food production (partly because of an effort dating from the Colonial era to develop extensive cash crop farming). Its government is extremely dependent on foreign and multilateral sponsors and regulators (from the World Bank and IMF through UN agencies to the US and other bilateral donors); its organisation reflects that dependence as much as any attempt to carry on autonomous affairs.

Commenting specifically on the creation of autonomous implementation units, Rondinelli writes:¹²

Some may become so dependent on external financial and technical support that they respond

more readily to international assistance agency priorities than to the needs of their own clientele. Yet, these problems are far less dangerous in most developing countries than not having widespread administrative capacity, for recent experience suggests that it is difficult to control complex and uncertain projects entirely from the center.

In an aid-dependent economy, it is easy for the whole government apparatus to take on the features Rondinelli ascribes to autonomous implementation units. This is a strong argument against relying on foreign aid in excess of amounts which domestic administrative apparatuses can oversee. The project described here aimed to strengthen precisely that domestic administrative apparatus, not so much *vis-à-vis* other Sudanese organisations, but rather in relation to the flow of aid from abroad. Though there may be something to Moris's¹³ argument for 'engaged planning', and even to his (perhaps overstated) view that successful implementation of development programmes cannot be a matter of routine administration by existing bureaucracies, it is still important that a Third World state should be able to monitor (and potentially administer) its relations with foreign governments and multilateral agencies. States may be inefficient, rigid and/or undemocratic, but in the modern world system, national autonomy depends on having a reasonably effective government.

The Sudanese central government is quite weak (a problem it shares particularly with other African states).¹⁴ Not only does it have organisational/administrative problems, it is very poor. Government officials are paid salaries a tiny fraction of those in the private sector—let alone those commanded by similarly educated people internationally—with the result that many of the best leave for jobs elsewhere. Client status reaches into the specifics of what the government can do with its meagre funds, as most famously in IMF controls,¹⁵ but also in less well organised pressure from a range of specific donors. The government is politically weak because it has no clear base of popular (or even sectional) support on which to chart any path dramatically deviating from the status quo; it must, therefore, focus primarily on immediate problems.¹⁶ Absence of physical infrastructure makes it difficult to coordinate activities on a national scale. Telephone communication is minimal even in the capital; electric power is erratic in Khartoum and non-existent in much of the country; there is one paved inter-city road, running two directions from the capital, and large parts of the country lack even all-weather tracks and are consequently cut off from most communications and transport for months at a time. Finally, the Sudan, like many other very poor countries, faces severe recurrent problems from drought to flood, crop failure to market collapse, civil war to religious revolution.

It is easy to see the difficulties faced by anyone who would attempt serious economic planning in such a setting. Whatever the difficulties may be, however, there is still an important role for policy analysis and strategic planning. The government's inability to keep track of currency, agricultural production, and foreign loans and grants are major impediments to day-to-day economic well-being, let alone development. We are not alone in this view. The World Bank's recent report on Sub-Saharan Africa¹⁷ identifies both (a) weaknesses in policy analysis and administration, and (b) the lack of effective planning institutions to coordinate development activities and donor aid as major impediments to

economic development.¹⁸ World Bank staff have extended the same analysis in their agenda for reform of financial and planning activities in the Sudan.¹⁹

Despite the widespread recognition of this problem, however, multilateral and bilateral donors have found it difficult to go beyond the sort of general support for planning which generates ritual practices but little practical efficacy. Part of their problem has been a difficulty in getting sufficiently deep access to and/or involvement in the institutions of planning and economic management. Micro-computers offer a very attractive vehicle for this access. The computers are glamorous, working with them is both intellectually compelling and prestigious, and the machines have a capacity to engage users well beyond initial attraction. This appeal to the machines makes computerisation efforts attractive to external agents of change because they can provide an entrée into the policy analysis process as well as improvement of it.²⁰ Computerisation efforts may provide access without providing substantive improvement, of course. Moreover, the extent of the latter depends not just on technical systems development but on the integration of the system and its supporting procedures into the actual policy-making process. Nonetheless, computers can function as 'catalysts' in the change process; they can help to set the process itself in motion, as well as to achieve certain technical goals within that process.²¹

Our project in the Sudanese Ministry of Finance and Economic Planning was designed to use computerisation as a catalyst for more general improvements in information management. The initial impetus for our work came from the Joint Monitoring Committee, a body in which both foreign donors and the Sudanese government are represented, and which is charged with donor coordination and oversight of Sudan's reconstruction and aid efforts. The Committee was concerned to improve administration of aid programmes. The USAID solicited proposals for a computerised database on foreign loan and grant activity. Our initial contract, thus, was to establish a microcomputer-based system which would provide information on all current and recently completed development projects. This 'project directory' would include data on project objectives, financing, location, implementation, donor involvement, training and the like. USAID funded the development of this system, which was to be located with the Secretariat of the Joint Monitoring Committee (the Secretariat being a unit of the Ministry of Finance and Economic Planning). The project directory was to provide a central depository of information on development efforts which would, it was hoped, improve donor coordination and communication and assist with the Joint Monitoring Committee's reporting tasks.

Almost as soon as work began, however, our project grew to include three additional tasks. The first addressed a central concern of both donors and the Sudanese Ministry of Finance and Economic Planning: delays in aid disbursements. The donors thought the fault lay with the Government of Sudan's ponderous aid approval and planning apparatus; the Ministry argued that it was due to the donor's massive paperwork and reporting requirements.²² We were thus asked to help develop a financial accounting system to keep track of transactions involving foreign loans and grants managed by the Ministry. Secondly, we were asked to design a database to monitor the flow of commodities

purchased as part of foreign aid programmes. Later, a support system for preparation of the Government's annual development budget was added to our scope of work.²³

Because paper-based information management in all these areas was minimal, our approach was to focus on computers as the medium for introducing information management procedures; we could not just try to computerise existing tasks. We opted for an incremental approach in which a separate, autonomous software system would be created for each task, so that failure of one system would not destroy the whole effort. The nature of the difficulties can be summed up by noting that at the outset neither the government of the Sudan nor anyone else had a cumulative database indicating what development projects were under way or in the planning stage. While some (but not all) foreign donors had current accounts on their transactions with the Sudan, neither the Sudanese government nor anyone else attempted to keep accounts for the whole range of aid activity. The Sudanese Finance Ministry, indeed, was not in a position to say how far its lines of credit were drawn down at any one time, how much of last year's budget had actually been expended, or whether the statements of Sudan's debts proffered by particular lenders were accurate. In short, we found ourselves charged with creating a system to balance a large part of the government's international 'cheque book' and keep its loan accounts up to date. We produced a database on development projects in Sudan using dBASE III (c. Ashton-Tate); our financial accounting system, commodity assistance tracking programme and development budget preparation package all run in LOTUS 1-2-3 (c. Lotus Development Corp.). We delivered several IBM PC series computers and assorted peripherals, and conducted moderately extensive (though still insufficient) training.

Our project does not in itself transform, or even very directly affect, planning. Rather, it begins the process of creating the database necessary for any serious policy analysis. Whether that policy analysis will follow is a separate question. Indeed, it seems in retrospect that our project, like many other efforts to tackle similar problems, may have concentrated too much on the information management technology and not adequately recognised the need to proceed simultaneously with an effort to develop procedures and expertise for policy analysis.²⁴ Of course, it may be that there simply is no mandate from the ministerial level for genuine policy analysis within the bureaucracy.²⁵

In the present paper, however, we want to turn, not to policy analysis, but to possible lessons our experience may offer about the distinctive issues facing efforts to introduce computerised management information systems in settings such as government bureaucracies in poor and aid-dependent countries. A government planning organisation in such a country has several distinctive characteristics. These set it apart from the settings in which most computer implementations and studies of the computerisation process have taken place. We can do no more here than merely to summarise some of the most important of these.

1. Planning ministries exist more to serve and placate donors than to plan economic activity, let alone monitor the implementation of plans. This means, first, that explicit agendas may in fact be secondary to various purposes never made explicit. Secondly, the domination of Ministry activity by attention to external donors makes it difficult for the Ministry autonomously to

establish effective administration. Thirdly, the dependence of Ministry officials on their ability to manage relations with the agents of donors distorts the relationship they will form with any technical advisors, such that a computer consultant cannot help but be treated as an agent of the donor ultimately paying for his or her services.

2. Organisations responsible for physical implementation of development programmes will be accustomed to a high level of actual autonomy from the planners who nominally monitor and bring order to their work.²⁶ They will therefore be likely to resist the development of any management information system which allows effective monitoring of their performance. In the Sudan, at least, this unintended autonomy is due not only to administrative failure but to the absence of developed transportation and communications infrastructure. It is important to recognise that computerisation efforts cannot take for granted the presence of such an infrastructure and the information flows it would ordinarily engender.
3. Poor and highly dependent economies present extremely unstable environments for computerisation efforts. Not only are physical facilities problematic, but human inputs are highly unreliable. A shortage of trained employees means that any computerisation effort must incorporate a substantial training component, but simultaneously face the likelihood that its trainees will rapidly be siphoned off into the private sector, other government organisations, or, as the presence of oil-rich Arab countries made likely in the Sudan, into the general brain drain which plagues weak economies. The severity of problems facing such economies makes long-term planning difficult, which in turn means that the mandate to pursue the development of any one computer system for any one purpose may be very unstable.
4. Where most organisations in relatively advanced countries have already gone through several planned changes in management information and accounting systems—including not only a variety of paper-file systems, but often previous experience with mainframe and other computers—counterpart organisations in poor countries are likely to have made only *ad hoc* changes in an overall system developed years ago. This means (a) that they will be unfamiliar with the process of planned organisational change which must accompany a substantial revision of information management procedures; (b) the structure into which computers are being brought will be one lacking many features of preparation (ranging from ordinary keyboard skills to any idea of paper flows) which are taken more or less for granted in advanced economies; (c) the distinctive advantages of specific technological arrangements (e.g. the decentralisation which microcomputers allow) may not be appreciated; and (d) the existing system may be fragmented by an organisational habit of multiplying units rather than reforming overall structures.
5. In aid-dependent countries, computerisation efforts often originate with donors, rather than within the organisations where they will take place. This means (a) that there may be only relatively slight organisational commitment to the new system; (b) that it may seem an external imposition on organisational life; and (c) that it may even appear as the intrusion of foreign technology into a sensitive domestic environment.

Despite these problems, planning ministries and similar organisations in many aid-dependent countries stand to benefit a great deal from computerisation. Most importantly, computerisation offers virtually the only effective way of gaining control over information, especially financial accounts, comparable to that of donor countries and other external organisations. Secondly, computers offer the potential to help ministry staff subordinate their information management and certification tasks to genuine efforts to plan economic development activities and to monitor the performance of those placed in charge of them. Microcomputer technology makes this feasible in a way that previous computer technology never did. It is much less expensive than mainframe or minicomputers; it can be implemented more or less piecemeal rather than requiring an initial commitment to a very large system; and it can be operated more easily in hostile physical environments (like the Sahara desert, which encroaches on the capital of Sudan)

than earlier computer technologies could, and individual machines can continue operating while others are down.

We turn now from the broader milieu and organisational context of this computerisation effort to specific issues in the implementation of a 'computer package'.²⁷

Implications for Design and Implementation

Empirical studies of computerisation in the United States and other technologically and economically advanced countries are still in their infancy.²⁸ Implementation efforts, however, are guided by a shared understanding of the process which, though produced partially in an *ad hoc* way, is nonetheless incrementally advanced by reports on more and more projects. Our effort here is to specify some of the ways in which our project suggests that computerisation efforts in settings such as the Sudanese Ministry of Finance and Economic Planning may differ (or not differ) from those in more autonomous and/or system-rich environments.

In the rich, technologically advanced societies, we think of microcomputers largely by contrast to mainframe technologies (indeed, in many cases, by contrast especially to earlier mainframe technologies). We are apt, thus, to stress possibilities for decentralisation, building on earlier pushes for distributed computing.²⁹ We may praise the equalising, even democratic potential of small computers.³⁰ While the power of mainframe computers may remain essential for some tasks, the current excitement in the field and the potential for social transformation come from the possibilities for widespread computer use and the easy individual access which microcomputers offer.³¹ Microcomputer technology shows considerable promise as a means (and occasion) for the decentralisation of bureaucratic powers for which many critics of current administrative practices call.³²

In the Sudanese Ministry of Finance, however, we found that microcomputers were perceived and managed as if they were mainframe computers. For example, we recommended putting the computers on the desks of those with responsibility for the tasks being computerised. Ministry officials, however, rather strongly preferred to form a separate Management Information Systems Unit. This was not simply a matter of senior officials maximising their power, or of the computer-specialists-in-the-making protecting their turf (though it was both of these). Rather, almost all personnel at all levels shared this centralised, mainframe orientation to the machines. One reason was probably the influence of an image drawn from films, reading and other casual familiarity with an older generation of computers. Others no doubt included the microcomputer's strangeness, high cost and relative complexity compared to any other technology in staff experience (manual typewriters are scarce in the Ministry). Still another was an unwillingness to accept computer use as a part of one's ordinary job—an apparent increase in responsibility. Last but not least, no members of the Ministry staff had ever had to suffer the difficulties of very centralised computing. They had never worked through centralised mainframe computing as a stage of system development—the normal condition of microcomputer use in organisations with deeper computer experience.³³

With regard to matters of power, we see no reason to dispute the contention of the members of the University of California at Irvine's URBIS project. Studying mainframe and minicomputer implementations in local governments (in what is probably still the most thorough social scientific study of the organisational dynamics of computing), they found that computing does not so much modify or redistribute power within an organisation as reinforce the existing power structure.³⁴ In the Planning Section of the Ministry of Finance, that existing power structure was one which apparently worked through many levels of administration but in fact centralised nearly all power in the person of the Undersecretary (the senior civil service official in the Ministry).

In our project, as in others, different participants acted from different and by no means all technologically oriented motives. Lower level trainees saw possibilities for career advancement in the training they received. Upper level managers tried to 'annex' the project to expand their power bases within the Ministry. Those anxious to have better access to data were primarily those engaged in project monitoring. They saw the system as a way to solve problems with the accounting section.³⁵ Members of the accounting section were correspondingly threatened by the new system which held a potential threat to their jobs.³⁶ USAID saw advantages in improved access to the Ministry as well as in improved Ministerial administration; some other donors saw this project as competition and limited participation accordingly. All this is familiar enough in the literature and lore of bureaucratic politics, but technical consultants need to keep reminding themselves that there is no escaping from bureaucratic politics into the realm of technical rationality. Our efforts to deal with the bureaucracies of both donors and the Ministry brought constant reminders that a full 'computer package' must include people and technique (including management) as well as hardware and software. Computing is always embedded in a complex 'web' of human relationships.³⁷

The notion of a computer package is a convenient way to break down our remaining observations and specific recommendations. We deal first with equipment, then people, then technique (a category which includes computing policies, information flows and organisational structures):

EQUIPMENT: KEEP IT SIMPLE

Reliability is more important than 'state-of-the-art' in hardware

The number of unanticipatable problems is multiplied in a physically hostile environment. Repair services in the Sudan were extremely limited not only in absolute terms but in kinds of problems they could solve. This stems from the country's absolute poverty, from the low level of previous computer and other technological systems use, and even from its dependence on foreign aid. The last limits equipment choice to those products manufactured in donor countries, and may introduce problems (e.g. availability of hard currency or stable direct relationships with vendors) in securing a ready supply of parts. The issue is not just that technology must be imported from industrial countries—already a problem—but that many donors will give funds only for the purchase of goods manufactured in their own countries. Such strings impede any rational and

coordinated equipment purchasing policy in the governments of aid-dependent countries. US government procurement policy systematically undercuts computer vendors in charity economies not only by requiring purchases to be made from US manufacturers, but by following lowest bid price rules which eliminate local vendors. Tying aid to purchases in donor countries is done to ensure that government spending on foreign aid boosts the donor's own economy and (in the case of capitalist countries) the private interests of the donor's manufacturers. Lowest bid price rules simply represent an attempt to manage costs and combat corruption. Unfortunately, keeping initial prices down in this way does not always keep long-term costs down. Moreover, undercutting the position of local vendors is both antithetical to the professed goal of development, and damaging to the immediate task of computerisation to the extent that it minimises the development of support systems. Even where local purchases may be precluded, local maintenance contracts would be helpful; foreign donors characteristically do not make any provision for later maintenance of the goods they provide. This is also an argument in favour of 'brand name' purchases, insofar as they provide not merely prestige but a much better chance of service in remote settings.

An easy-to-maintain, simple system is better than an easy-to-use but more complex system

In the US, software development has moved towards increasing internal complexity in an effort to achieve 'user-friendliness'. User-friendliness is of course a desirable goal anywhere, but an extremely unstable computing environment (like that in the Sudan) makes flexibility essential. Difficulties in training and retaining employees mean that any system will have to be easily learned. Few highly skilled people will be available to 'maintain' or modify software. Users will not be able easily to buy a new system or hire new technical advisers as applications change. Turnkey systems which work fine at the start will tend to fail because of lack of software maintenance or a changed organisational environment.

Observable, interactive, visually-oriented systems stand a better chance of succeeding than 'black box' or batch systems

The interactive friendliness and visual appeal of microcomputers is an important virtue to be maximised—even at the cost of system power. Shared goals and boss's orders are often insufficient motivations for learning to use a system. We found an ability to see the program do its work to be important not only in teaching new users, but in explaining the workings of our systems to the senior decision makers in both Sudanese Government and donor bureaucracies. No one ever paid much attention to, really understood or even wished to understand the system based on dBASE III; it will probably not be used very much. Those based on Lotus 1-2-3 caught the attention of all sorts of people during demonstrations and generated an interest that will probably translate into more effective use.

Systems with modular, decentralised component parts will be more likely to survive

Highly integrated systems have undeniable advantages, but not as first (or early) computer implementations in very unstable, poorly developed computing

environments. It is important to remember that systems will always fail. In a modular system, the failure of one sub-system will not cripple the whole. Not only are technological reasons not entirely controllable, but there are political/organisational reasons for failure. In the Sudan, the Presidential Palace for a time overruled the Ministry of Finance's authority to enforce development budget allocations. If work on the budget itself (the ultimate unifying system of our project) had to stop, the other information management functions could proceed separately. Moreover, implementing one module at a time allows for an iterative feedback process to inform the whole effort (see below).

PEOPLE: TRAINING AND ORGANISATION ARE KEY FACTORS

The success of any computer application will be determined largely by its effect on the career paths (and remuneration) of individuals

One serious difficulty our project faced was providing career tracks for the computer personnel we trained. USAID and the Sudanese managers were unable to establish a fair method of additional pay to people who could dramatically increase their salaries by leaving the Ministry as soon as we trained them. One of our better pupils secured a part-time position paying *ten* times her government salary. Over time, such problems could become one of the greatest barriers to further introduction of computer technology. However, the answer must be more, rather than less, training.

Training a few people to very high levels will not be as effective as training many people to lower levels

The highly trained specialists will, in the absence of very expensive inducements, probably leave. It might make more sense, anyway, for such experts to be trained through the usual educational channels. Only spreading training widely will help the organisation as a whole to become a hospitable environment for computer applications. It will make computer training less of a scarce 'property' to be controlled by individuals (or their supervisors) for personal advantage. It will encourage many more employees to feel an investment in the new systems rather than hostility toward them.

Training must include senior decision makers as well as junior staff specialising in using a particular system

Senior officials cannot be expected to make good policy decisions regarding computerisation efforts without general knowledge of the equipment and systems in question. Moreover, they will shy away from discussing the crucial questions if they think that junior staff under them will discover them to be ignorant. Special kinds of training are needed for senior officials who need to understand a system but are not expected to use it hands-on. First, the senior officials will very likely consider it 'inappropriate' to receive training side by side with the junior staff (even the middle range managers for whom we designed one course failed to come after the Undersecretary decided that several very junior staff should also attend).

Prior technical training and/or use of machines is an important predisposition to success in computer training

In the advanced economies nearly everyone deals with a sufficient range, variety and complexity of mechanical and electro-mechanical appliances to be at least superficially familiar with how any specific device, such as a microcomputer, works. All manner of general information we may take to be obvious is not common currency in a system-poor environment. In a very poor country, even fairly well educated people may find it hard to learn the basic orientation to the machine which is essential. For example, many people were totally unfamiliar with an English keyboard and typing skills in general. This proved a major obstacle for some individuals. The same problem may occur separately from direct machine use. Progress on our project directory was recurrently delayed as a series of committees redesigned forms for data gathering. We had failed to communicate both that a database structure need not be precisely a copy of the visual appearance of data on a form, and that changing kinds or definitions of data for various fields would necessitate restructuring the database. As Kaplinsky has noted, 'the recognition of the systemic nature of technology is not something that can be left to common sense. It requires a specific recognition in the structure of training programs, right across the skill spectrum.'³⁸ People with engineering background tended to do better in our course than those who studied mathematics or economics. That, however, raises another problem: such people often had little interest in economic planning or financial management and only worked in the Ministry for lack of a job more appropriate to their training.

TECHNIQUE: DEVELOPING THE COMPUTING ENVIRONMENT

Technical efficiency in itself is seldom a sufficient reason for adoption of an innovation

The gains from such efficiency (a) may be spread very thinly through the organisation as collective goods not of sufficient benefit to anyone for him or her to sponsor the innovation; (b) may be offset by loss in personal power on the part of an important decision-maker; or (c) may not be accompanied by a corollary improvement in personal situation in the organisation. Generally, every application, no matter how self-evident its benefits may seem, requires an enthusiastic and powerful sponsor with the organisation.³⁹ One sub-system which we proposed, for example, offered a fairly obvious gain in efficiency. Budget preparation—a task on which half a dozen staff work for several months each year, and in which burdensome and repetitive clerical and arithmetical work overwhelms policy analysis—was computerised in 50 man-hours, including both system design and data entry. Revisions which previously necessitated lengthy and error-ridden human recomputation were rendered routine. But the computer system was not fully or enthusiastically implemented, as best we can make out, because no one saw a direct gain. It would probably have cut the staff of an important section head; at the same time (against our advice) the physical computer (the potential reward) would have been located in the centralised MIS Unit, rather than in the section whose work would be computerised.

Any system which requires a new information flow, however reasonable or efficiently designed, will be more likely to fail than one which does not

Systems should be designed to make maximum use of existing information flows in order to make data collection as simple as possible. It proved much easier for us to develop software systems than to get the data collection organised to make the systems worthwhile. One should not underestimate the sheer shortage of reliable data, or the difficulty of getting government officials to do research to find data. Indeed, those who possess new computer skills seem particularly prone to feel that they are above searching for or checking over data. While professionals may see computers as worthy of their attention, they think of dealing with data as a mere clerical matter (even when, as in our case, clerical assistants able to do this work are not available). Consultants need to build a substantial plan for implementing data collecting and management processes into their plans, rather than assuming that these will follow easily from good system design.

Applications should be computerised incrementally to allow the implementation experience to influence the design, and to increase organisational fit and commitment

Implementation of this principle may run counter to the prevailing emphasis on top-down programming, but as Simon has suggested, 'complex systems will evolve from simple systems much more rapidly if there are stable intermediate forms than if there are not'.⁴⁰ Within the Ministry we found little appreciation of the need for accurate paper records. Ministry personnel did not themselves understand the flow of information from donors and within the Ministry. At the beginning of the system development process, virtually no one understood what was being computerised. As a result, it was necessary to design a simple system prototype, partially implement it to show how it worked, then gain the benefit of comments from Ministry staff who began to understand better what was going on, and what the range of possibilities were.⁴¹ Verbal explanations are no substitute for seeing the systems at work. Any system which is designed completely in advance will tend to be less well suited to user needs, and less accurately understood by users. It is also easier to keep the systems simple when they are developed modularly.

Implementations should be planned to promote rather than subvert development of a country's support-systems for computing

Both within a particular organisation and in a country as a whole, we think it likely that the biggest gains from early computerisation efforts will be contributions to the creation of a stable, supportive computing environment which will allow future implementations to be made at higher and higher levels of sophistication and efficacy. One of the strengths of microcomputer technology as opposed to mainframe computing, of course, is the lower level of infrastructural support it requires. Nonetheless, it requires a fair amount, and much of that may be lacking in developing countries. At present, applications tend to undercut the growth of better computing environments by (a) failing to buy from local suppliers, (b) failing to use and support local computer specialists and institutions (such as university computer science departments or computer centres), and (c) failing to

provide as much training and infrastructural development as they might. Any turnkey system, for example, designed to be run by very low-skilled locals with high-skilled contributions coming only from foreigners minimises its contribution to developing a better computing environment.

Summary and Conclusions

During the next few years, microcomputers are likely to become increasingly common in even the poorest Third World countries. In aid-dependent economies, especially, they hold the potential to help greatly in meeting particularly acute problems of national administration and mediation between donors, planners, and those who carry out actual development projects. These countries, however, are extremely unstable and inhospitable computing environments. The nature of the earliest implementations will play a major role in determining how rapidly overall progress can be made, not only because they will serve as models, but because they will create either rich or poor environments for later implementations. Moreover, the distinctive features of these environments suggest that consultants and others engaged in introducing computers into them need to orient their work in somewhat different ways from what they might do in a more technologically or economically advanced country.

The issues we have suggested do not arise primarily from differences in individual abilities or motivations, nor even from general education levels. Rather the key differences stem from the distinctive problems of (a) the nature of the planning process in poor and aid-dependent countries; (b) the introduction of microcomputers into organisations which have not used previous generations of computers (or often even of paper-based record-keeping and accounting techniques); and (c) the extreme instability of computing environments. The last is, in turn, largely the result of (a) organisational and infrastructural weakness; and (b) the fact that even in the middle to late 1980s computers are new in such settings. Applications, therefore, are unable to benefit from the higher level of general knowledge and support-systems which bolsters the use of computer systems in the industrialised countries.

Despite the problems which will continue to plague computerisation efforts, we think that microcomputers are an appropriate technology for administrative work in charity economies. With sensible design and implementation, they will meet an important need. This need, moreover, is increasingly being recognised by major international organisations and by various Third World governments. Consultants will be called upon to develop systems, many of much greater magnitude and potential importance than that on which we have worked. It is desirable to specify how features of computing environments determine the outcomes of computerisation efforts and the best implementation strategies. The present paper offers only extrapolations and suggestions from a case study. We hope, however, that it can contribute to the analysis of the effects of differing computing environments by showing some of the implications of a relatively extreme case: computerisation in the development planning bureaucracy of a very poor, very aid-dependent country, with minimal previous experience of computers or other formal

information technology and management systems. The case is extreme because it unites two phenomena, each of which is more common: (a) a lack of organisational autonomy, signified in part by the predominance of external pressures in the push for computerisation; and (b) a lack of supporting technical infrastructure and prior experience with information systems. The problems we have cited do not make us think computerisation intrinsically unfeasible or undesirable in such settings. On the contrary, we think that computerisation can play a valuable role in enhancing administrative efficiency. This is useful not only for direct economic gains, but because it gives aid-dependent countries a better chance to gain control of the development efforts which take place within them.

NOTES AND REFERENCES

1 As Hyden, G. points out in *No Shortcuts to Progress: African Development Management in Perspective*, Berkley, University of California Press, 1983, pp. 64–65, there may also be potent domestic political reasons for development planning. A national plan, for example, may provide a political leadership with an authoritative document by reference to which it can defend its preferred programmes against challenges. Planning efforts may also divert attention from present problems to promised future improvements. Such political uses of planning, of course, increase the chances that plans will be treated formalistically and often rigidly as 'blueprints', and offer fairly limited tangible gains for development.

2 Rondinelli, D., *Development Projects as Policy Experiments*, London, Methuen, 1983; Robertson, A. F., *People and the State: An Anthropology of Planned Development*, Cambridge, Cambridge University Press, 1984.

3 As Killick notes, 'Finance Ministries are a particularly frequent target' of those who seek to explain the failure of development planning. They are 'often said to undermine the planning agency by resisting the co-ordination of plans and budgets'. This is one reason why the Sudanese government several years ago consolidated its Finance and Planning Ministries; the two are for the most part integrated in name only, however. And operations would provide ample examples for those who find the causes of planning failure in 'failings on the part of the administrative civil service: cumbersome bureaucratic procedures; excessive caution and resistance to innovations; personal and departmental rivalries; lack of concern with economic considerations' (Killick, T., 'The Possibilities of

Development Planning', *Oxford Economic Papers*, 28 (2) 1976, pp. 161–166).

4 In Sudan, indeed, the combination of brain drain, deteriorating educational institutions, and political interference with the civil service has caused the loss of a large part of what once had been a relatively efficient and well trained bureaucracy.

5 Whether the merits of using computers in development administration are great or small, innumerable international agencies and Third World governments have chosen to promote their use. The US Department of Agriculture has even sponsored the writing of a textbook on *Microcomputers in Development: A Manager's Guide* (Ingle, M., Berge, N. and Hamilton, M., *Microcomputers in Development*, West Hartford, CT, Kumarian Press, 1983). Since widespread implementation seems guaranteed, it is appropriate to try to establish how it might best proceed.

6 See Robertson, A. F., *op cit*.

7 Abu-Lughod, J. ('Culture, Modes of Production and the Changing Nature of the Arab World' in Agnew, J., Mercer, J. and Sopher, D. (eds.), *The City in Cultural Context*, London, Allen and Unwin, 1984, pp. 94–119) has provocatively termed these the 'charity-economies' because of their high level of dependence on external grants and loans. In addition to being provocative, the definition is slightly ambiguous. Even relatively well-off countries with a considerable ability to influence the terms under which they receive aid (e.g. Israel) might fall into this category. Moreover, while most charity-economies are poor, it is not the case that all very poor countries receive comparable amounts of international aid or other financing. Here, however, we are concerned

particularly with those countries which are both poor (not just in income terms but in other indicators of material development) and heavily dependent on external finance.

8 Morss, E. R., 'Institutional Destruction Resulting from Donor and Project Proliferation in Sub-Saharan African Countries', *World Development* 12 (4) 1984, pp. 465–470.

9 Hyden, G., *op. cit.*, pp. 165–168; Morss, E. R., *op. cit.*

10 Robertson, A. F., *op. cit.*, p. 3.

11 In this paper we will use the term 'donor' to refer generally to those agencies which lend money as well as those who give money and resources. This includes national aid organisations as well as the IMF and other multilateral organisations. These all lend money at preferential rates and/or under conditions at which ordinary commercial loans would not be available. They are plausibly considered donors, while commercial creditors are not. Certain other organisations act primarily as regulators and/or information managers, mediating between donors, private creditors and recipient governments. For the issues discussed in this paper, the differences are minor.

12 Rondinelli, D., *op. cit.*, p. 133

13 Moris, J., 'The Transferability of Western Management Concepts and Programs. An East African Perspective' in Stifel, L., Coleman, J and Black, J. (eds.), *Education and Training for Public Sector Management in Developing Countries*, New York, Rockefeller Foundation, 1977, pp. 73–83.

14 See Hyden, G., *op. cit.*, pp. 60–63.

15 See Brown, R., 'International Responses to Sudan's Economic Crisis: 1978 to the April 1985 Coup d'Etat', *Development and Change*, 17, 1986, pp. 487–511

16 While our project was under way, the government changed in a coup d'état which, however, did not fundamentally alter the applicability of the preceding statement. Since the completion of our project, the Sudan has installed its first democratically elected government in many years. This government will almost certainly have a firmer basis for making significant changes in socio-economic policy than did the Numeiri regime in its last years. Whether it has a sufficiently firm basis (and the will) to contemplate truly fundamental changes remains to be seen. Civil war seems only to have grown in intensity, which may act as a severe limit of the government's range of choices. Moreover, some international organisations have withdrawn from the Sudan or severely curtailed their operations there on the basis of a perceived

terrorist threat. The duration and implications of this are also unclear.

17 World Bank, *Accelerated Development in Sub-Saharan Africa: An Agenda for Action*, Washington DC, World Bank, 1984.

18 See Roberts, R. S., Jr, 'Aid Modalities in the Sudan', study for the United Nations Conference on the Least Developed Countries, Review Meeting for Sudan, Addis Ababa, 4–15 May 1981.

19 See Ridker, R., 'Sudan: Planning and Budgeting for Recovery', World Bank Mission Report. Ridker's report called for a wholesale transformation of procedures in the Ministry of Finance and Economic Planning, basically to bring them into accord with modern textbook desiderata for public administration and accounting. Sudanese rejection of this very elaborate proposal was part of the occasion for the more moderate intervention described in this paper.

20 Whether these would-be change agents have a legitimate claim to such access, or will use it productively, remain, of course, separate and open questions. Nonetheless, the value of computer technology in securing such access, and the importance of information management to their analyses of problems in developing countries, does ensure that such agencies will continue to sponsor computerisation efforts. They may or may not make explicit any of the broader goals which accompany their technical assistance.

21 Pinckey, T. C., Cohen, J. M. and Leonard, D. K., 'Kenya's Use of Microcomputers to Improve Budgeting and Financial Management in an Operating Ministry: An Updated Report' (Development Discussion Paper No. 169), Cambridge, Mass., Harvard Institute for International Development, 1984

22 There was perhaps some truth to arguments on each side (see also Roberts, R. S., *op. cit.*, p. 55). As Rondinelli, *op. cit.*, p. 3, notes. 'Paradoxically, as development strategies changed during the 1970s to address more complicated and less controllable problems of human development, procedures for planning and managing projects became more rigid and routinised'. Though we have not yet had the opportunity to see, we wonder whether computer use will exacerbate this tendency towards routinisation, rigidity and formalism. There were hints of this in the way many bureaucrats approached the MIS implementation: obsessing over the design of forms, for example, while not worrying at all about the quality of data. There is nothing inherent in computer technology to

require such formalism, but it is a technology readily amenable to such a style of use.

23 A more detailed description of the project and the software systems developed by the authors can be found in Whittington, D., Calhoun, C. and Drummond, W., 'A Microcomputer-Based Management Information System for Development Planning in the Sudan', Report to the US Agency for International Development, 1986 (extract available from the Development Studies Program, Department of City and Regional Planning, University of North Carolina).

24 The distinction we wish to draw here is not the familiar one between 'tool-oriented' approaches and those which stress political transformation (see Siffin, W., 'Two Decades of Public Administration in Developing Countries' in Stifle, L., Coleman, J. and Black, J. (eds.), *Education and Training for Public Sector Management in Developing Countries*, New York, Rockefeller Foundation, 1977, pp. 49–60). Rather, we are working with the assumption that whatever the merits of political transformation (in the Sudan or elsewhere), such transformation cannot in itself adequately substitute for administrative effectiveness. The distinction we draw in the text is between administrative procedures and the machines which may aid them, on the one hand, and the actual process of substantive policy analysis, formulation and performance monitoring on the other. The effort to improve the former without directly addressing the latter may be mistaken, especially in a setting where the latter are extremely minimal.

25 For further information on this problem elsewhere in Africa, see Hyden, G., op. cit., pp. 69–75. More generally, see Waterston, A., *Development Planning: Lessons of Experience*, London, Oxford University Press, 1966; Seers, D., 'The Prevalence of Pseudo-Planning' in Faber, M. and Seers, D. (eds.), *The Crisis in Planning*, London, Chatto and Windus, 1972; and Killick, T., 'The Possibilities of Development Planning', *Oxford Economic Papers*, 28 (2) 1976, pp. 161–166.

26 See Rondinelli, D., op. cit., pp. 133–136

27 Kraemer, K. L. and Danziger, J. N., 'Computers and Control in the Work Environment', *Public Administration Review*, 44, 1984, pp. 32–42.

28 King, J. L. and Kraemer, K. L., *The Dynamics of Computing*, New York, Columbia University Press, 1985; Danziger, J., 'Social Science and the Social Impacts of Computer Technology', *Social Science Quarterly*, 66, 1985, pp. 3–21.

29 The Diebold Group, *Rethinking the Practice of Management: The Impact of Data Processing*, New York, Praeger, 1973; Nora, S. and Minc, A., *The Com-*

puterization of Society, Cambridge, Mass., MIT Press, 1980.

30 See Evans, C., *The Micro Millennium*, New York, Norton, 1980; Naisbitt, J., *Megatrends*, New York, Warner Books, 1982.

31 Danziger, J., op. cit.; Calhoun, C., 'The Microcomputer Revolution? Technical Possibilities and Social Choices', *Sociological Methods and Research*, 9, 1981, pp. 397–437.

32 On Third World settings, see the review in Blair, H. W., 'Review Article: Reorienting Development Administration', *Journal of Development Studies*, 21 (3) 1985, pp. 449–457; Rondinelli, D., op. cit., pp. 133–136; Perez, C., 'Microelectronics, Long Waves and World Structural Change: New Perspectives for Developing Countries', *World Development*, 13 (3) 1985, p. 456.

33 King, J. L. and Kraemer, K. L., op. cit. Of course, centralisation versus decentralisation of computing is a recurrent dilemma everywhere: see Kling, R. and Scacchi, W., 'Recurrent Dilemmas of Computer Use in Complex Organizations', *AFIPS Conference Proceedings*, 48, 1982, pp. 107–115; and King, J. L., *Centralized vs. Decentralized Computing: Organizational Considerations and Management Options*, Irvine, Public Policy Research Organization, University of California, 1983.

34 Danziger, J. N., Dutton, W. H., Kling, R. and Kraemer, K. L., *Computers and Politics: High Technology in American Local Governments*, New York, Columbia University Press, 1982. See also Kraemer, K. L., Dutton, W. H. and Northrup, A., *The Management of Information Systems*, New York, Columbia University Press, 1981.

35 We also thought the accounting section was genuinely problematic. It seemed to be an 'information sink' into which pieces of paper flowed but from which no usable data was forthcoming. The pieces of paper might record transactions drawing funds from foreign banks to pay contractors on development projects; for example, the accounting section was charged with approving the payments by countersigning the disbursement requests. Payments were not regularly balanced against requests, however, and neither were used to keep a running balance of funds available. Rather, entries were made chronologically in a ledger which was never totalled, and the pieces of paper were stacked in boxes. Attempts at reconstructing the 'paper trail' of particular projects revealed that in most cases at least a few of the relevant pieces of paper were missing from the boxes.

36 The problem was not unique to the accounting section, however, or explicable

simply by its internal dynamics. The Sudanese Ministry of Finance and Economic Planning fits Rondinelli's (op. cit., pp. 144–145) image of an organisation which discourages the detection and correction of errors, which would be punished, and instead encourages the inefficient suppression of information.

37 Kling, R. and Scacchi, W., 'The Web of Computing: Computer Technology as Social Organization', *Advances in Computing*, 21, 1982, pp. 1–90.

38 Kaplinsky, R., 'Electronics-based Automation Technologies and the Onset of Systemofacture: Implications for Third World Industrialization', *World Development*, 13 (3) 1985, p. 435.

39 See Moris, J., op. cit., p. 127.

40 Simon, H. A., *The Sciences of the Artificial*, Cambridge, Mass., MIT Press, 1969, p. 209.

41 See Naumann, J. D. and Jenkins, A. M.,

'Prototyping: The New Paradigm for Systems Development', *MIS Quarterly*, 6, 1982, pp. 29–44 on a 'prototyping' approach to systems development. In development planning itself, there has recently been renewed recognition of the need for experimentation and pilot projects for similar reasons (see summary in Rondinelli, op. cit., chapter 4). Commenting on a microcomputer implementation in a Portuguese development project, Ingle, M. and Connerly, E., ('Application of Microcomputers to Portugal's Agricultural Management' in Bhalla, A., James, D. and Stevens, Y. (eds.), *Blending of New and Traditional Technologies: Case Studies*, Dublin, Tycooly International Publishing for the International Labour Office, 1984, pp. 47–65) express a similar preference for 'a participative, iterative process rather than single-minded, blueprint pursuit of planned products'.

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