Exploiting the Full Potential of Information Technology:
Implications for the Organization and Operation of National Statistical Offices[1]

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1. Introduction

The basic functions of a statistical agency include collection, dissemination and analysis of statistics. These are the broad functions commonly found in National Statistical Offices (NSOs), but in some cases entities within the national statistical systems also maintain registers of population and vital events. Meeting the needs of data users is the primary goal common to all national statistical services. Within that goal, improvement of the timely release of data, their quality and accessibility have remained as major objectives. Countries face many challenges in achieving these objectives.

Developments in information technology (IT) and its potential in enhancing the capabilities of NSOs to achieve their goals have underlined the need for the optimum use of such technology in statistical operations. Despite the initial outlay, the use of IT reduces the overall costs of statistical operations, improves the timeliness and quality of statistics and creates a better working environment by reducing routine work. In the area of dissemination, IT applications provide easier access to information resources of the NSO and assist in improving the quality, consistency and timeliness of the hardcopy statistical publications. They enable a faster response to client data requests and provide greater opportunities to develop new products and services. In the area of data collection and processing, faster and flexible capture of data through OMR/OCR, computer and/or telephone assisted interviewing, and computer-assisted coding have resulted in remarkable gains, notably in the more advanced NSOs of the Asia-Pacific region. Unfortunately, in most of the developing country NSOs the gains from the IT applications have not been as impressive, despite the availability and affordability of IT options.

The rest of the paper examines the current state of IT application in the ESCAP region, with focus on three selected areas -- networks, GIS and the year 2000 problem-- and discusses implications for the organization and functioning of the NSOs in the region.

2. Application of Information Technology in the ESCAP region

The ESCAP region's statistical offices are at different stages of IT development. Some advanced national statistical offices have a personal computer on almost every employee's desk, whereas in others, computers are shared by several workers. Table 1 provides some latest

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[1]The views expressed in this paper are those of the author and do not necessarily reflect those of the United Nations.

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information, though provisional and for 23 responding countries only, from a survey being conducted by the ESCAP secretariat. Traditionally, NSOs have maintained a data processing unit and thus, as would be expected, most of the NSOs have reported the presence of IT personnel in their organizations.

The IT personnel as a proportion of all NSO personnel varies from 2 per cent in the Philippines to 27 per cent in Singapore. However, caution should be exercised in interpreting such an information, as statisticians can also be skillful in computer applications. Four small countries/areas (American Samoa, Guam, Maldives, Marshall Islands) reported that they did not have any IT personnel as such; evidently some of their statisticians are also computer users.

The ratio of NSO staff per PC serves as an indicator of computerization development. Among the medium-sized and large NSOs (with 100 or more staff), Australia, Japan, New Zealand and Singapore are clearly best equipped with at least one PC per staff. The Republic of Korea also has a high ratio with close to one staff per PC. Macau and Hong Kong (China) also have quite favorable ratios, with less than 2 staff per PC. At the other extreme are Bangladesh, Myanmar and Sri Lanka, with 8 to 15 staff per PC. In Indonesia, Malaysia and Philippines, the ratio of staff per PC varies between 3 and 4.

In small NSOs (American Samoa, Bhutan, Fiji, Guam, Lao PDR and Marshall Islands), the staff to PC ratio varies between 0.5 and 2, perhaps by virtue of their size.

The number of network connected PCS, when compared with the total number of personnel in the NSO, provides a good indication of IT development. Among the countries listed in table 1, four of the advanced NSOs (Australia, Japan, New Zealand and Singapore) show a 1:1 ratio of network-connected PC to staff. The ratio is also quite high for Hong Kong (China) and the Republic of Korea while three small NSOs (Fiji, Lao PDR and Macau) have at least one network connected PC per four staff. In the remaining one-third countries/areas, the ratio varies between one PC per seven staff to as low as one PC per 70 staff.

Seven NSOs have used, or are using, OCR/OMR for data capture; among these five have also reported the use of GIS.

Networks and the Internet

During the past few years, local area networks (LANs) have been introduced in many statistical offices. In the more advanced countries, Governments have developed wide area networks (WANs) connecting various government departments, including statistical agencies. The Internet has experienced a phenomenal growth, connecting millions of users in the world. It has opened up new opportunities in all areas of statistics from data collection to data dissemination and marketing. However, there are still several obstacles in the utilization of the Internet, including the lack of understanding of the scope and the potential of the global network, particularly at the decision-making level.

The World Wide Web (WWW) within the Internet constitutes a global, user-friendly, interactive and dynamic facility with enormous potential for improving the management of information resources. In addition to its graphical interface, E-mail, news groups, telnet and FTP

(file transfer protocol), the documents and resources can be hyperlinked on the webpage. These powerful facilities open up a range of options for disseminating statistics and metadata. Several advanced countries have already established facilities exploiting these options and are seeking further improvements. However, little attention has been given to these areas in the developing countries of the region. Where some progress has been made, often it has been through the efforts of dedicated individuals.

In order to exploit the potentials of the Internet, the NSO must review and reorganize its structure, reorient its way of functioning, acquire required hardware and software and train its staff on such aspects as web publishing. Even for making a start on the homepage, for example, by placing textual information describing the NSO including its products and services, progress will be hampered if various sections of the NSO do not have some capability in web publishing. Experience in the ESCAP region indicates that the NSOs setting up www pages for their offices had initially required additional resources, but the burden decreased later on as the updates became routine work. However, once on the Internet, NSOs must update their Web pages frequently so that their relevance and usefulness is maintained. Successful development of any component in the information system usually creates new expectations and new demands. It is in the interest of the NSO to live up to those expectations.

The homepage itself may contain the E-mail facility through which users could send data requests. That will again require appropriate arrangements for handling such requests. Frequently-accessed statistics and simple common tables may be placed as links to graphic files, while larger files may be made available through the links for downloading. However, the issues of copyright, pricing, mode of charge and restrictions on the use of information do arise. Besides, data provision through the Internet may reduce the sales revenue of hard copy outputs. A number of private firms repackage data obtained from NSOs and sell it for profit. With the availability of data through the Internet and other electronic media, such exploitation of data from the private firms is likely to increase. NSOs will have to tackle this and other related issues at the policy level. Currently, some countries such as Singapore, have introduced charges recovering costs for the service. Furthermore, access to a larger body of data is allowed only to a selected group of users. To establish such systems, additional hardware and software are required and, depending on the technological development in the country, the end-user might also require some sort of gadget for deducting charges.

So far only 10 NSOs (Australia, Hong Kong (China), Indonesia, Japan, Macau, New Zealand, Philippines, Republic of Korea, Singapore, Turkey) in the ESCAP region are known to have gone on-line to use the full Internet connection and establish World Wide Web (www) pages on the Internet. However, this is a considerable improvement compared to the situation in 1996, when only 4 NSOs had homepages. Statistical agencies are using the Internet as an added distribution medium for products and information that were previously disseminated through conventional means only. Besides corporate data and information about statistical products and services, the NSO Internet sites offer key country indicators, either in html-format or down-loadable spreadsheets, and links to useful statistics-related resources including other NSO home pages.

Table 1: Application of Information Technology in selected countries of ESCAP region[1/]

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Selected countries in ESCAP region	Population (in thousands)	Number of employees in NSO		% of IT personnel	Number of PCS in use	Number of network-connected PCS	Use of scanners, OMR, OCR	Use of GIS	Software used for analysis
		Total	IT Personnel						
American Samoa	59	50	-	-	41	8			..
Australia	18,898	2,845	329	12	3,280	3,280	●	●	Supercross, SAS, Mapinfo, Excel, Lotus123
Bangladesh	124,178	4,428	362	8	286	125	●	●	Harvard Graphics, SPSS, ARC/INFO, FrontPage97
Bhutan	1,922	26	4	15	13	-			..
Fiji	822	70	9	12	40	22			SAS, Excel
Guam	160	53	-	-	32	-			ISP, Microfit
Hong Kong, China	6,700	1,495	91	6	795	467			SAS, SPSS, Excel
Indonesia	204,336	11,942	664	6	2,778	840			SAS, SPSS, Mortpak, FIVSIN, PEOPLE
Japan	126,380	1,823	101	6	2,000	2,000	●		Excel, SAS, ARC/INFO, Mapinfo
Lao, PDR	5,354	50	..	..	26	22			Excel, Microsoft Word
Macau	458	256	22	9	181	180			SAS, Mortpak
Malaysia	22,174	1,710	181	11	421	240		●	Lotus123, Excel, SAS, QUICKTAB, REDATUM, PEOPLE, Mortpak
Maldives	268	5	-	-	..	2			SPSS, POPMAP, PC-EDIT, PEOPLE, Mortpak
Marshall Islands	61	6	-	-	12	-			PEOPLE
Myanmar	47,602	311	63	20	35	10			..
New Zealand	3,763	729	94	13	922	922	●	●	Supercross, SAS, Excel, MS Words, Lotus based PAS
Pakistan	141,680	..	..	..	11	-	●		..
Philippines	72,070	3,055	76	2	948	250			SAS
Republic of Korea	46,444	1,281	127	10	1,111	1,104	●	●	Own program developed in-house, SAS, PL/I
Singapore	3,929	212	58	27	249	249	●	●	SAS, FASTAB
Sri Lanka	18,459	1,183	143	12	124	-			SPSS, PEOPLE
Turkey	64,747	2,741	126	5	730	40		●	..
Turkmenistan	4,313	212	...	...	...	...			..

[1/] Preliminary information obtained through a survey being conducted by ESCAP and supplemented by other sources.

Besides e-mail and hypertext applications, the Internet also offers access to USENET news groups, and facilitates remote direct access to distant databases at the command level (TELNET) and file transfer from any part of the network (FTP). A particularly useful feature of the Internet is its information search facilities and the capacity to provide machine-readable information faster than any other medium. However, concerns regarding data security and integrity assume importance and are needed to be further studied and explored by the NSOs. Another implication of using the Internet for dissemination of statistics is the need to distribute statistical data together with their metadata; otherwise, misinterpretations of statistics are very likely to occur.

Geographic Information Systems (GIS)

Information from other sources indicates that, in the ESCAP region, countries that have used GIS in statistics have reported a high demand for location-specific products and services. As a consequence, some advanced statistical offices are already in the process of redesigning their GIS that had been developed less than a decade ago. In contrast, some other NSOs have yet to make a start in using GIS in statistics. GIS are used for presentation of land and natural resources data and for displaying statistical data that are available for a mapped area, or data values that pertain to known coordinates. The public sector employs GIS for land-use monitoring and mapping, management of public utilities, transportation planning and tax zoning, among other uses. The private sector is highly interested in the possibilities of exploiting GIS in the planning of marketing campaigns and in locating their offices and sales units. Several countries have made considerable efforts to digitize maps of their enumeration districts so as to use GIS in their future censuses.

Several NSOs have cited the benefits derived from GIS technology when planning censuses and surveys and presenting their results in a more user-friendly format. One problem cited, however, is that agricultural maps and GIS data tend to follow agricultural and climatic zones and often cannot be used together with data that are based on administrative areas. Nevertheless, it should be possible to solve the problem with adequate coordination between the responsible government agencies.

For some purposes, users want GIS-based data for relatively small and precise geographic areas. When data are thus disaggregated or based on individual persons, households or businesses, the issues of confidentiality and protection of the privacy of the reporting units must be addressed.

The year 2000 problem

The year 2000 (Y2K) problem is another example of an important factor in IT applications with far reaching implications in a statistical organization. The problem is quite complex and potentially more harmful than it is commonly understood. The resolution of the Y2K problem poses extraordinary challenges for all public and private organizations, including NSOs. It deserves attention not just because it is a technical problem, rather it is a matter of managerial

responsibility and corrective action as organizations depend on each others' computer systems. The resolution of the problem involves an organization-wide effort, human and financial resources, and outsourcing. While in several countries of the region the mass media has provided a wealth of information on the Y2K problem, it is felt that the awareness of the problem is not sufficiently high in most statistical offices in the Asia-Pacific region.

Only the most advanced NSOs have made organization-wide Y2K plans which are now under implementation. In those plans, usually top management has assigned accountability for solving the Y2K problem to each department, which are headed by senior middle managers; the departments have to report periodically to a high-level management group on their progress. At the organization level, a dedicated coordinator strives to raise awareness of the problem and maintain inventories and resource bases, including Web links to Y2K sites on the Internet. The advanced NSOs rely on in-house solutions, rather than outsourcing the problem solving.

There is no doubt that eventually many less advanced statistical offices will not be able to solve the problem by themselves. Nevertheless, the heads of those agencies should not avoid the responsibility of initiating Y2K risk analysis and should take action to prevent lurking catastrophes. It should also be recognized that the IT departments of NSOs could not alone be held responsible for solving the Y2K problem; over-reliance on one department to solve the whole organization's problems contains a high risk. The less advanced NSOs in the Asia-Pacific region can employ multidisciplinary and team approaches adapted from the models of more advanced offices. Identifying the implications of failure of any of the systems would help in identifying mission-critical applications to be fixed first. The less important systems could be fixed when the time and resources allowed. Rules and procedures for hardware and software acquisition should also be reviewed and revised; as a rule no new system should be acquired without certification of its Y2K compliance.

3. Implications for the NSOs

Policy environment conducive to IT development

During the past two decades, IT applications in NSOs often depended on the vision of the data processing personnel, where the organizations acquired various aspects of technology as permitted by their budgets. The migration from main-frame to PC-based environment as well as the introduction of network computing and latest operating systems turned out to be a chase for a moving target, without much regard to the overall needs of the organization and future technological developments.

Now that a number of various components of IT have matured and their likely trends are better understood, planning for the future may not be as difficult. Over the past few years, some of the developed countries in the ESCAP region embarked on plans to redevelop their IT infrastructure. Unfortunately, not many NSOs in the developing countries of the region are focussing on developing an overall IT policy for their organizations. There is also a need to

establish and strengthen coordination with other departments for developing some IT areas, such as GIS.

To achieve an effective application of IT, NSOs must set goals for IT development and formulate strategic plans to achieve them. The top management must understand technological issues and terms as well as the role of information technology in the organization. It further needs to identify IT development areas and potential ventures, deciding to invest in only those that offer the best benefits for the organization. After management has decided to create an information system, it should remain committed to developing the system and be continuously involved in the development process through a capable management team which has the authority to approve, cancel or delay the project. New information systems may require changes in the organizational structure, information policies and management practices.

Organizational structure

While introducing various components of IT, the organizational structure of the NSO will also be affected. There will be a need to decentralize certain applications, such as data capture and database management. The introduction of client-server computing adds new dimensions to database management by providing user-friendly interfaces for such tasks as data retrieval, updates and the management of data integrity. Another development is distributed computing, which is basically client-server computing on a wider scale, but data are located on many servers. These servers might be at geographically dispersed areas, connected by wide area network (WAN) links. These developments highlight the age old issue that the national statistical offices have grappled with -- to centralize or distribute?

The client-server data processing model allows a number of users to access common server resources, which are centralized. Distributed computing on the other hand means that data, like other resources, are controlled in various locations of the organization. Organizations may thus find themselves simultaneously creating centralized server databases and providing access to decentralized data holdings.

Organizationally, information system development can be broken down into internal projects and modules, which are easier to manage than projects that have too distant goals and that may suffer from a lack of ownership and commitment by the organization. Some primary considerations must be taken into account in screening a proposed development project. First, all projects should support mission priorities outlined in the organization's strategic plan. The application of IT should not comprise an end by itself, rather the aim should be the improvement of the information system. Second, a series of questions must be asked. Are there commercial off-the-shelf packages available to achieve most of the project's goals? Are there similar applications elsewhere, in the national civil service or other NSOs in the region, that can they be acquired and used to meet the project requirements? How does the project fit into the agency's technology and information architecture? Next, the capacity of the agency to design and execute

the planned project must be considered. Lessons learned in other government agencies that have implemented similar projects should be incorporated into the project plan.

Human Resources Development

The rapidly evolving IT has increased the demand for training, but most NSOs have difficulties in coping with the change. The demand for IT training is still bound to grow tremendously. Some statistical agencies have the definite intention to leapfrog in applying IT in their offices; that can only be achieved by significantly increasing resources on IT purchases and human resources development.

In addressing the human resources development issues it must be recognized that, on the one hand, IT professionals working outside NSOs seldom have a thorough knowledge of statistics, which is a prerequisite in designing functional statistical information systems. On the other hand, there is a lack of IT skills among statisticians. It is therefore apparent that hybrid strategies, which would include enhancing the IT skills of statisticians and the use of general IT experts, would be needed. The statistical offices would also benefit by involving statistical units of other government agencies in sectoral IT development work.

Standardization

Information technology standards concern operating systems, networking protocols, programming languages, database management systems, and electronic data interchange (EDI). Various popular industry products, such as operating systems, often become de facto standards by virtue of their proliferation. In one country, for example, the local language version of an operating environment has become the standard despite its apparent shortcomings, as no other party is willing to invest in improving the situation. Nevertheless, it is important to recognize the need for adopting open/generic standards. For widely-used applications such as databases it is necessary to employ some common standards.

Hardware and Software Acquisition and Support

Being able to buy higher performing equipment for less money does not necessarily mean that the overall costs of information technology will fall. New pieces of hardware need to be installed and configured, staff must be trained to use new software, and time and money are required for their maintenance. Smart IT investment strategies aim at reducing the future costs rather than concentrating on the management or minimization of the current expenditure. The time of replacement of IT equipment is not usually defined by the degree of physical wear to the equipment or software, but by their useful life.

Without the standardization of the hardware and software applications within the NSO, it would be difficult to maintain an effective management of data collection, processing and dissemination activities. The use of standards should be judicious and have the objective of

facilitating inter-operability; they should not introduce inflexibility. Another key to effective utilization of information technology is the availability of maintenance as well as reliable and sustained support. In the case of software, it is important to ensure that support, future corrections, and updates would be forthcoming. In the past, some software for survey data processing and analysis were made available to the developing countries free of cost. However, as new operating systems were introduced for more powerful PCS, those software could not be upgraded due to the lack of support from the developers, resulting in difficulties and frustrations for the NSOs.

4. Discussion

The previous discussion has highlighted the implications of exploiting the full potential of IT for the NSOs in the Asia-Pacific region. It emphasizes that the application of IT is more than hardware and software purchases. The value of IT as a whole is much higher than the sum of benefits drawn from its various components. It is clear that NSOs have to review their corporate culture, data systems, procedures and practices, and organizational structure to exploit the full potential of technology. The issues that have been identified also lead to a number of questions which deserve further information and investigation.

If the benefits of IT are so obvious and computing more affordable than ever, why is the computerization of information management still difficult for many NSOs?

Perhaps, the very rapid pace of IT development itself has played a part in hampering its progress as many NSOs found it easier to resort to the haphazard use of basic information technology, rather than systematically monitoring innovations and working towards the establishment of a statistical information system.

The challenge for NSOs is to plan and implement a strategy for exploiting the potential of existing IT while simultaneously taking into account future developments in technology. The nature of technology applications will change not only because of evolving technology options but also due to demands from data users.

Technologically speaking, NSOs in developing countries are in a position to leapfrog in information technology development. However, that still requires support of the decision-makers and awareness among them of the benefits that information technology can offer to their country. Enlisting the support of the decision-makers would involve different strategies in different countries and requires further exchange of information and discussion.

Similarly, the necessary financial commitment would be required, but again how would one ensure that, especially in view of the current financial crisis in Asia? An exchange of experiences in this area would also be helpful to NSOs in developing countries.

As for the review of the organizational structure and procedures of the NSOs in

developing countries, and introduction of changes, would it be appropriate to adapt the models from experienced developed countries? Would there be any implication for the staff and the statistical operations and service?

Application of IT in NSOs has far reaching implications for human resources development. It is clear from the above discussion that NSOs will have to invest in the development of human resources and capability-building in the organization for monitoring technology trends and for identifying applications that offer the best benefits for the organization. When it comes to training, what would be the best strategy? How much reliance should be placed on in-house training? What would be the role of the academic institutions? What role the international agencies and their training programmes can play?