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INTRODUCTION

Over the previous decade, several Asian countries have launched initiatives to promote the use of information systems and technology (IS/IT) in various development sectors. These initiatives are the subject of this paper, which presents information gathered by the United Nations Centre for Regional Development (UNCRD) in its ongoing Research and Training Project on Information Systems for Planning.

This paper will focus on the roles that are being played by central and local governments and universities in encouraging the use of IS/IT. Central government ministries or departments have played an active role in many of these initiatives. Some of these efforts were encouraged by aid grants or loans; and in some cases, central agencies have made innovative use of their budgets. In addition, the reorganization of planning departments may have provided the stimulus for the development of IS/IT. Some central agencies created new IS/IT projects or expanded existing ones, while others developed joint projects with universities.

Government-led IS/IT initiatives are usually undertaken in conjunction with development plans or programmes. A characteristic feature of these projects is the inclusion of government commitment and support and external financial or technical assistance for IS/IT development and sustainability. Most of these projects are in their initial implementation stages, so it is too early to tell what their effects on planning and development will be. Nevertheless, these initiatives represent hopeful beginnings in the Asian countries; increasingly they are used in information retrieval and geographic and land information systems (GIS/LIS). However, there are very few planning information systems in these countries.

Universities and research and training centres also play an important role in IS/IT development in Asia. They offer courses or training programmes on IS/IT, provide consulting services or technical assistance, and conduct IS/IT projects in cooperation with central and local governments, aid agencies, and the private sector. This review of IS/IT initiatives suggests that given effective collaboration between the government, academic, and business communities, these universities and research and training centres can enhance IS/IT development. Whether university-based IS/IT projects can be moved out of the experimental or pilot/prototype stage however, will depend on whether long-term institutional and financial

support can be developed or strengthened, and whether they are oriented towards the needs of government or other sponsoring agencies.

Local governments develop IS/IT projects as part of their urban development programmes. The information city initiatives described in this paper suggest that central government assistance and high-technology industry participation are important factors in the success of networked cities.

To better appreciate all these diverse efforts, this paper will report on IS/IT projects under way in Asian countries.

This review has adopted the following definition of IS/IT. IS is defined as "a framework in which the flow of data to information is enabled through various forms of purposeful processing".1/ IT on the other hand is any set of tools which can be used in "the collection, storing, processing, and transmission of information, including voice, data, and images".2/

CENTRAL GOVERNMENT INITIATIVES

Central governments are becoming increasingly active in promoting the use of information technology. UNCRD identified a number of information systems projects undertaken by government ministries or departments. The majority of these projects are relatively new, and deal with microcomputer applications in natural resource management, land information management, land-use planning, rural development, development planning, and project management.

Applications in Natural Resource Management

Natural resources are crucial to the livelihoods of people and a declining ability to manage such resources contributes to increasing poverty and food insecurity in developing countries. The role of information in resource management and monitoring has been identified as being central to the conservation of biodiversity, prevention of environmental degradation, and sustainable development.

At the UNCRD-Universiti Brunei Darussalam International Seminar on Resource Management and Spatial Planning in Developing Countries: Geo-Information Technology Perspective, held in April 1992, in Brunei Darussalam, the use of GIS in resource management was well understood, as were the obstacles to its effective use. The observations made at the seminar may hold important lessons for the formulation of appropriate GIS technology policies.3/

(1) There is a general lack of awareness of GIS technology and principles;

(2) Generally, people are not yet quite accustomed to thinking spatially and integratively, which are two important ingredients for effective GIS implementation in resource management;

(3) The unavailability of trained people and reliable data are the two most significant inhibitors to the sustainable use of GIS;

(4) Many of the problems relating to data acquisition and lack of standardization are institutional in nature; they include the lack of free flow of information; the need to define responsibility in the proper use and representation of data, including data accuracy, consistency, and integrity; and data security.

(5) There are important social and cultural differences among people in developing countries that are unique and will be the overriding factors in defining GIS needs.

The application of information technology in resource management remains the central concern of a number of agencies in Asian countries. From 1969, BAKOSURTANAL (the National Coordination Agency for Surveys and Mapping), Government of Indonesia, had begun to collect information on resource potential and environmental conditions.[4] BAKOSURTANAL's Land Resource Evaluation and Planning Project, jointly funded by the Asian Development Bank and the Government of Indonesia, is currently developing a land resource data base and a multipurpose, integrated GIS for land resource planning, and training personnel in computerized data management and GIS application in physical planning. As such, it is responding to an issue of increasing concern in Asian countries -- the shortage of well-trained staff in the operation, management, and application of GIS.

The Philippines, too, has a well-established National Mapping and Resource Information Authority (NAMRIA) (formerly the Natural Resources Management Center), Department of Environment and Natural Resources.[5] For the last sixteen years, NAMRIA has been using remote sensing technology as a support tool for the Department's environmental and natural resource management activities. NAMRIA continues to place importance on research on remote sensing and GIS applications, education and training, and laboratory facilities, through the Philippines-Australia Remote Sensing Project.

In China, the Laboratory of Resources and Environment Information System (LREIS), founded in 1985, is concerned with conducting basic and applied research in GIS technology.[6] Its research efforts focus on the development of the Natural Environmental Information System of China, the Loess Plateau Information System, the "Three-North" Forest Shelterbelt Ecological Benefit Dynamic Monitoring System, the Flood Risk Forecasting Information System in the Yellow River, the Resources and Environmental Information System in the Dongting Lake Region, and the Regional Information System in the Beijing-Tianjin-Tangshan Area. These initiatives should be further strengthened to facilitate transfer of research findings from the laboratory to the local and regional governments with the aim of assisting local and

regional planning. LREIS is a joint project of the Institute of Geography, Chinese Academy of Sciences, and the State Planning Commission.

Applications in Land Information Management

In many parts of Asia, development is taking place rapidly and intensively. The demand for up-to-date maps and accurate land information has increased dramatically for planning purposes. The traditional, manual methods of map production, record keeping, and land and property inventory are said to be expensive and time-consuming, and can no longer cope with the growing demands generated from the public and private sectors.

Recently, attention has been focused on the development of automated or computer-assisted LIS for cadastral management and fiscal purposes and the collection of land-related information for urban and regional planning.

Hong Kong, Malaysia, and Indonesia, for example, are currently implementing LIS projects. The Land Information Centre of the Buildings and Lands Department, Hong Kong Government, has made advances towards setting up a land data bank and developing applications using LIS technology.[7] Information being collected to support Hong Kong's requirements for survey and mapping, town planning, and land administration include basic maps at the scale of 1:1,000 covering the whole territory; land records showing private lots and temporary land disposals; and town planning layouts and urban area land use. The strategies for implementation put forward by the Buildings and Lands Department include the involvement of the end users, the land information managers, the hardware and software vendors, the educators, the academic institutions, and the public to foster a viable LIS.

A similar initiative in Malaysia to modernize the land registry and set up a land inventory information system is under way. The Ministry of Land and Regional Development (now Ministry of Rural Development), with the assistance of the Central Board for Real Estate Data in Sweden, is developing a LIS at federal and state levels.[8] It will take several years for the Ministry to fulfill this idea of a computerized LIS. The Ministry has prepared an eleven-year workplan for the LIS, that includes the establishment of a communication network and the expansion of the system to Sabah and Sarawak.

Indonesia began an Urban LIS Project in 1986 and completed the project in 1989.[9] The system was developed primarily for tax assessment and collection. The project was implemented jointly by the Land Research Center, Directorate General of Agraria (now the National Land Agency), Ministry of Home Affairs, and a consortium of consultants. It was financed by a grant from the French Government.

Applications in Land-Use Planning

Useful applications for IT can also be found in land-use planning. There are projects where IT is bringing some demonstrable benefit.

A notable example is Singapore's Integrated Land Use System (ILUS), established by the reorganized Urban Redevelopment Authority (URA) in 1989.[10] Although ILUS is still in the early stage of development, it is envisaged that it will provide effective support to the urban planning and development activities of the URA and the Public Works Department. The project design provides for twenty subsystems which will be developed in two phases over a seven-year period. Phase I (1989-92) comprises a turnkey pilot system for the development of application systems for the processing of land development and building construction permits, road planning and construction, long-term land development and infrastructure planning, and district land-use planning. Phase II will undertake the development of the remaining subsystems. ILUS applications involve the integration of GIS, management information systems (MIS), and office automation (OA) technology. The ILUS project demonstrates how one organization is attempting to apply IT for coordinating urban planning functions.

Other countries which are beginning to use IT in land-use planning are China, Indonesia, and Sri Lanka. In China, the Guangzhou Urban Planning Automation Center at the Urban Planning Bureau, Guangzhou, Guangdong Province, has developed a computer-aided design (CAD) system for residential district planning, a computer-aided urban planning and design system, and computer models for analysis and forecasting.[11] The system is totally operative not only as an instrument for urban planning and management, but also for many other uses, especially for urban construction and estimation of investments for large-scale land uses.

Indonesia has two GIS projects: [12] the GIS for Land-Use Planning Project, initiated in 1984 by the Land Use Directorate, Ministry of Home Affairs, to enhance the BAPPEDAs (Regional Development Planning Boards) planning capability to use mapped information; and the GIS for Kalimantan region, also introduced in 1984 by the Ministry of Home Affairs, and supported by the German Government and Government of Indonesia counterpart funds. The Kalimantan project aims to improve the land use and mapping systems in four provinces.

Sri Lanka's Land-Use Information System focuses on the creation of geographic, cadastral, and soil data bases.[13] Three agencies are involved: the Survey Department, the Irrigation Department, and the Land Use Policy Planning Division of the Ministry of Lands, Irrigation and Mahaweli Development. The Asian Development Bank has provided loans for the project. The project is seeking to improve institutional linkages that will permit data sharing among agencies, improve the data base for planning, as well as improve the capabilities of planners in using digital data.

Applications in Rural Development

Several countries reviewed for this paper -- including India, Sri Lanka, and Thailand -- have established information systems as important components of government rural development programmes. In India, the Computerized Rural Information Systems Project

(CRISP), launched in 1986 by the Department of Rural Development, with technical support from the National Informatics Centre, was pilot tested in ten districts spread over different states and is reported to have been fully implemented in other districts across the country.[14] CRISP has developed a software for the planning, monitoring, and evaluation of anti-poverty programmes. The system produces standard reports; furthermore, it is said to detect administrative irregularities thereby increasing official accountability in programme implementation. The origins of CRISP began in 1983 in Karnataka State.

In Sri Lanka, a MIS was developed to facilitate monitoring and evaluation of the integrated rural development projects.[15] The MIS has three modules -- Financial Module, Physical Module, and a GIS. The Regional Development Division, Ministry of Policy Planning and Implementation and the Netherlands Management Development Foundation sponsored the project. The first districts that implemented GIS projects were Nuwara Eliya and Kalutara districts. Other districts followed their lead -- Moneragala, Puttalam, and Kandy districts. This GIS project experience indicates that data organization and the development of a suitable format for a data bank and mapping system are critical factors in GIS implementation.

The Rural Development Information System (RDIS) in Thailand was initiated to alleviate data needs identified by the National Rural Development Coordination Center (NRDCC) at the National Economic and Social Development Board (NESDB).[16] One impetus for the system is the government's decentralization policy. The system provides information support for national rural development planning and provincial development planning; plan coordination at *tambon*, district, and provincial levels; and monitoring and evaluation. The system was set up in 1982 and has a highly structured data base containing data from all 55,000 rural villages. Some of the problems of implementing the system include the need for assistance and training in data collection and manipulation and in computer operation, and the absence of service and maintenance facilities in remote provinces.

Applications in Development Planning

From this survey of central government initiatives it is clear that a variety of special-purpose spatial and land-based information systems are being implemented in many Asian countries. There is no doubt that GIS and LIS which are based on geographic, cadastral, and site-specific information, are increasingly used in these countries. However, they are not sufficiently developed to support planning applications. Therein lies the need for planning information systems to support nonroutine planning tasks such as modeling, forecasting, design, and evaluation.

One of the few examples of an information system for planning in the Asian context seems to be the District Information System of the National Informatics Centre (acronym DISNIC), Planning Commission, Government of India. According to the Director of the National Informatics Centre, the Centre was set up in 1977 as an informatics service-oriented

organization to provide hardware, software, and processing support to various government departments, thirty-two state governments, and 440 district administrations.[17] The Centre has established a nationwide satellite-based computer-communication network (NICNET) to facilitate the development of information systems at the district level and data bases for state and central government departments. By 1990, DISNIC had developed five software programmes that are said to be user-friendly, menu-driven, and easy to operate. They include DISNIC-Agriculture, DISNIC-Education, DISNIC-Irrigation, DISNIC-Labour, and Natural Calamities Relief Management System. In 1991, DISNIC developed a programme called SC/ST Development for use in decision making, planning, and monitoring in the science and technology sector at the district/state level. Currently, the National Informatics Centre is attempting to integrate GIS into the network. Its GISNIC project aims at creating a map-based decision support system and a computer-based cartographic system.

The SETIA system in Malaysia is another significant centrally directed programme. SETIA has been launched by four powerful agencies (Economic Planning Unit, Treasury, Implementation Coordination Unit, and Accountant General's Department) and is concerned with project (financial) management and monitoring.[18] Under the *Sixth Malaysia Plan, 1991-1995*, SETIA's function was broadened with the introduction of a computerized project scheduling system known as the Integrated Application of Scheduling System (SIAP).

In the Philippines, much work has been done on the development of information systems for planning but mostly in isolation from each other. The Regional Development Staff of the National Economic and Development Authority (NEDA) had introduced a variety of information systems that were geared to the specific needs of particular projects. They included the Regional Statistical System Development (RSSD) Project, the Land-Use Information System Project (LUIS), the Regional Development Information System (REGDIS), and the Regional Project Monitoring System (RPMS).[19] These projects were implemented with the assistance of different aid agencies and were developed to serve the data needs of the NEDA regional offices. NEDA's earlier experiment with the Integrated Regional Information System (IRIS) Project, under the NEDA-UNDP-World Bank Regional Planning Assistance Project, 1975-83, stopped when donor support ended. Another NEDA initiative is concerned with the development of a software programme, ECOKNOWMICS, which takes the form of expert system application. The software is intended to "enable planners to obtain data more readily from the national economic data bases and to utilize more effectively the macroeconomic models available on NEDA computers".[20]

The Indian experience exemplifies the crucial role played by a highly advanced and developed information system for planning, while the Malaysian experience shows the importance of developing the capacity for project management and monitoring through information technology. Although progress in the implementation of these systems has been slow, policymakers and planners have come to recognize their value in planning. The

performance of both information systems should be further evaluated in terms of the achievement of their objectives. The Philippine experience, on the other hand, shows that sustainability is a problem as the projects were originally supported by aid agencies. The NEDA regional offices do not have enough resources to properly develop and maintain existing data bases.

UNIVERSITY-BASED IT PROGRAMMES

Universities and research and training centres are also playing an important, though limited, role in IT application. First, they offer courses, training workshops, and technical seminars; and provide computer laboratory facilities to students and trainees. Second, they disseminate information through newsletters, journals, and other publications; provide technical assistance; and perform special research for government, aid agencies, and the private sector.

Examples of such universities and training centres offering IS/IT training programmes[21] include the Asian Institute of Technology (AIT) in Bangkok; the Department of Information Systems and Computer Science, National University of Singapore; the Centre of Urban Planning and Environmental Management, University of Hong Kong; the Department of Geography, Universiti Brunei Darussalam; the Land Systems Computer Laboratory, Institute for Advanced Studies, University of Malaya; the Universiti Teknologi Malaysia in Johor; the University of the Philippines Training Center for Applied Geodesy and Photogrammetry; the Laboratory for Spatial Computing and Analysis, Department of Regional and City Planning, Bandung Institute of Technology; and the Department of Survey Engineering, Chulalongkorn University.

Some universities have also set up GIS projects in cooperation with aid agencies. For example, the Kirori Mal College at the University of Delhi developed the Bihar GIS Project (1989-92) at the request of the National Planning Commission, Government of India, with funding from the International Development Research Centre (IDRC), Ottawa, Canada.[22] In addition to its efforts to create a data base relating to the physical infrastructure in Bihar State, the project will demonstrate the decision support capabilities of GIS through exercises that are designed to integrate and analyse the data in the data base. The project will also emphasize technology transfer.

Another example of university/aid agency cooperative research venture is the GIS study for coastal zone planning and management in South Johor, Malaysia.[23] This pilot project was part of the ASEAN-US Coastal Resources Management Project, funded by the US Agency for International Development (USAID) and coordinated by the International Center for Living Aquatic Resources Management (ICLARM). The GIS study was prepared by a Universiti

Sains Malaysia research team, in cooperation with the Department of Fisheries, Government of Malaysia, between 1988 and 1990.

Research centre/government cooperation has also been formed to develop GIS projects. The Thailand Development Research Institute (TDRI) Foundation, with funding from the Ministry of Science, Technology and Energy, prepared an action plan for the establishment of a national GIS for natural resource management. TDRI has also undertaken several prototype GIS projects through research contracts; these include a MIS for the Thai-Australia Highland Agricultural and Social Development Project; the Siting Hazardous Waste Disposal Sites Project in Ratchaburi (commissioned by the Industrial Works Department); Land Reform Project Identification in Chantaburi (commissioned by the Agricultural Land Reform Office); Land-Use Planning in Chiang Mai Province (commissioned by the Department of Local Development); and GIS Application for Songkla Lake Basin (commissioned by the Prince of Songkla University).[24]

Examples of university/central or local government cooperative GIS projects include the Lake Biwa Environmental Data Base System created by the Lake Biwa Research Institute, in cooperation with the Environment Division of the Shiga Prefectural Government, Japan;[25] the GIS Study for the Selection of Solid Waste Disposal Site in Pundang Region, Republic of Korea, conducted by the Department of Geography, Seoul National University, in cooperation with the Korea Institute of Energy and Resources;[26] and the GIS for Nature Reserves Management, a joint project of the Singapore National Parks Board and the National University of Singapore.[27] In China, the Ministry of Construction and the Suzhou Urban Construction and Planning Bureau contracted with the Institute of Planning and Design of Tongji University, to develop the Suzhou Urban Planning and Management Information System (UPMIS) in Shanghai.[28] The system integrates the alpha/numeric data base management system (INFORMIX) with the graphic data edit system (AUTOCAD) to provide a spatial analysis capability. The system was applied in the conservation and renewal study of Suzhou old town as well as in other town planning studies in Shanghai.

In some cases, universities work with regional development authorities to demonstrate the use of geographic information in local and regional planning. An example is the Universiti Teknologi Malaysia which conducted a Decision Support System Project for Locating Potential Beach Tourist Sites in Pulau Langkawi, in the northwest coast of Peninsular Malaysia, and a Vector-Based GIS Project for Locating Key Settlements in the South East Johor Regional Development Authority (KEJORA) area.[29]

Some universities have also established programmes involving exercises and field work designed to provide students with practical experience in IT application. The Department of Geography, Universiti Brunei Darussalam, for example, has conducted a GIS project for rural land-use planning in Mukim Labi, Belait District, and has also developed a microcomputer-

based statistical analysis-cum-mapping system (MICROSAM) as part of a socioeconomic study of Kampung Ayer (Brunei's "water village").[30]

In the last few years, government/university/industry cooperative research ventures have been launched. In Malaysia, for example, a number of government agencies, universities, and R&D institutions have embarked on a Joint Advanced Research Integrated Networking (JARING) Project with the objective of establishing an integrated data communication network, enhancing R&D activities, and studying and enhancing the use of data communication technology and its impact on socioeconomic activities.[31] The JARING project was initiated in 1990 by the Malaysia Institute of Microelectronics Systems (MIMOS), Prime Minister's Department.

These university-based programmes serve as demonstration or "learning systems" which facilitate the application of IT on a wider scale. They not only prepare students for IT work but also address the needs of government and industry for training in IT and provide IT skills to their work force.

However, universities and training centres must determine how to meet public and private sector demand for IT education and training. There is now a growing concern about the lack of IT specialist skills, especially in industry. In Indonesia, for example, some groups advocate that universities should tailor their syllabi to fit industry needs. They complain that universities tend to follow foreign curricula and teach open systems skills instead of skills in the areas of data communications, mainframe operating systems, systems programming, project management, and applications development.[32]

ADVANCED INFORMATION CITY INITIATIVES

Many cities in Japan are moving ahead with their plans to implement the information city concept. Initiatives to achieve this objective differ between cities and are based on central government planning initiatives, which combine high-tech and communications industries with urban renewal projects.[33] These include: (a) the Advanced Information Metropolis Plan of the Ministry of International Trade and Industry (MITI), began in 1986, comprising projects such as distributed CAD/CAM systems and teleshopping experiments; (b) the Teletopia Project of the Ministry of Posts and Telecommunications, first initiated in 1982-83, designating sixty-three regional centres as experiments for city-wide videotex, cable TV, and communications systems; and (c) the Intelligent Cities Project of the Ministry of Construction, in which twenty-two model cities were selected as demonstration projects.[34]

A good example of the MITI plan is Minato Mirai 21, Yokohama's teleport project, which began in 1983 and is targeted for completion in the year 2000.[35] In a nutshell, the project envisages the redevelopment of the former dockyard/port area and the integration of the

city's central business functions. The project would make Minato Mirai 21 into a multipurpose "port city of the future." The city planners reckon that "by revitalizing the waterfront area ... and creating a new, more vibrant city centre in tune with the 21st century, Yokohama will also play a leading role in decentralizing the many business, industrial and administrative functions currently concentrated in Tokyo".[36] As an information city, Minato Mirai 21 will be the central point for an advanced information transmission network for international as well as inter- and intracity information exchange. Already some of the site's major facilities, including the General Information Center for data base development, have opened.

Japan's teletopia projects, such as the Area Network System of Suwa Prefecture[37] and the Cultural Data Base System of Tokushima Prefecture (called the Computer-Operated Multi-Exchange of Tokushima or COMET),[38] use advanced telecommunications and information services "to assist the formation and development of a comfortable regional society".[39] Suwa Prefecture (with 210,000 population), hoping to create a union of six municipalities, has built a low-cost regional information centre. On-line networking through seventy-two terminals leased to the municipalities, has provided automated services (e.g., standard tax forms, residence cards and seal registration, and medical services) and produced new applications (e.g., distance education, a broadcasting station manned by part-time students at Suwa University, conference services, and tourism).

The COMET System of Tokushima Prefecture (located on the eastern coast of Shikoku Island) is a source of information for bibliographies, modern art museum reference materials, events information, and video information. It is only in its infancy (as it was only set up in November 1990 to mark the 100th anniversary of Tokushima Prefecture) but it now offers access to the cultural data base, consisting of 467,000 items of information, through twenty terminals and ten telephone lines. The system appears to give some benefits to users (769 persons have been given ID cards, of which 70 per cent are prefecture residents) and provides user training but it is said to be expensive and involves a large commitment of human resources.

Of the Japanese cities identified by the government ministries for demonstration of the advanced information city, Kawasaki City (an industrial suburb of more than one million population, located between Tokyo and Yokohama) has become of particular interest in that it has fused its redevelopment and rezoning plans with the three ministries' plans.[40] The first of the city's initiatives involved the development of the Shin-Yurigaoka city centre as a model city project under the Ministry of Posts and Telecommunications' Teletopia Plan. Its second project was associated with the development of the original city centre as a model zone under the MITI Information Metropolis Plan. Its third project related to the development of five major development zones as model urban zones under the Intelligent City Plan of the Ministry of Construction; the zones include the technopia region, the original city centre, the new city centre, the Kanagawa Science Park, and the microcomputer city plan region. The final project

involved the development of a new centre for information infrastructure development undertaken by both the public and private sectors. Kawasaki City has been expanding these projects to cover a full range of IT applications. Its past initiatives have already attracted a great deal of attention both nationally and internationally.

The Japanese examples offer important lessons from the viewpoint of urban revitalization by building up strong information services and networks, as well as telecommunications infrastructures. They provide evidence that central government assistance and local public/private initiative and partnership are important conditions for ensuring viable development of networked cities. Further research is required into the impact of high technology and telecommunications on urban and regional economic development. But of equal importance is the social and organizational impacts of such networks. It is also important to examine the applicability of the Japanese model to cities and regions in developing countries. More studies of the information city in both developed and developing countries are required with an emphasis on the uses and the social and economic impacts of such networks.

FACTORS AFFECTING IS/IT APPLICATION

This paper has reviewed various initiatives designed to foster IS/IT application in development programmes or projects. Not all of the initiatives have been equally successful in promoting the use of IS/IT in national and local development. Given the differences in their objectives and strategies, the success factors are difficult to determine. Most of these projects have been launched in the last three to five years, and have not been evaluated, either internally by the staff or externally by consultants. Some are designed to support specific plans or projects in the short run, while others are building data bases for future use. As a result, this review of success factors is somewhat impressionistic, and does not attempt to assess the benefits or impacts of IS/IT projects on planning and development. A good project design, strong leadership, user involvement, education and training, and institutional, financial, and technical support are prerequisites for IS/IT application; these factors are often discussed in IS/IT studies so they are not elaborated here. In addition, the following factors contribute to success: Organizational culture and sustained efforts, local initiative and partnership, and social, economic, and political environment.

Some projects have benefited from an organizational culture that promotes IS/IT and a positive attitude about the use and potential of IS/IT. For example, the BAKOSURTANAL in Indonesia, the NAMRIA in the Philippines, and the National Computer Board in Singapore, have been working successfully for many years to achieve IS/IT objectives.

In the successful projects, most of the effort has been initiated and implemented locally. Some projects (e.g., the information city initiatives in Japan) received assistance from the

central government in developing their information services and complementing their urban renewal projects. Others have used their own budgets to implement projects (e.g., Singapore's ILUS, Hong Kong's LIS, and India's DISNIC).

In addition, collaboration or partnership between government, university, and industry plays an important role in successful projects. The collaborative success between these groups, however, depends on the degree to which they effectively exchange information.

Social and economic conditions affect the willingness and capacity of organizations to establish IS/IT projects, but more important is political stability that allows organizations to sustain projects and attract international cooperation or assistance.

There are other factors over which IS/IT projects have little control, such as physical conditions (climate and terrain), lack of information and telecomunication infrastructure and technology base, economic policies (e.g., import restrictions and foreign exchange policies); and tax policies (e.g., taxation of hardware and software). Thus the application of IS/IT is affected by the presence or absence of these barriers.

CONCLUSION

This review of IS/IT initiatives revealed over thirty projects under way on topics as wide ranging as natural resource management, land information management, land-use planning, rural development, development planning, and advanced information city. These institutional experiences in the design of microcomputer-based systems and their application reinforce the observation that IT (including GIS) is appropriate for developing countries. Microcomputers are increasingly used in a variety of activities ranging from administration and word processing, through project management and monitoring, to computer mapping. A variety of software programmes are in use, and in some countries, government agencies prepare their own software programmes. However, the lack of skilled IT personnel and the scarcity of planners with training in IT limits the use of computers in nonroutine planning tasks such as modeling, forecasting of population, housing, employment, and land-use change, design, and evaluation.

Training is seen in most countries as an area of some concern, although some universities and training centres are beginning to offer courses and training programmes in IS/IT.[41] A point often mentioned in UNCRD IS/GIS seminars was the need to train staff at all levels (including top decision makers, managers and supervisors, programmers and modelers, and technicians, digitizers, and processors). This is by no means the case in most countries, although some have organized regular staff training programmes on IS/IT. It is here that international organizations can play a role. They can provide training materials, videos, and facilities, and cooperate with national or regional institutions in organizing short training

courses, seminars, and workshops to increase the capacity of developing countries to use IS/IT. International organizations can also promote information technology cooperation aimed at enhancing the diffusion of information about IT and access to IT. Moreover, they can organize projects to increase the capacity of developing countries to select, develop, or adapt their own information and communication technologies according to their local needs and conditions.

This review has shown the diversity and scale of government-led IS/IT projects. It provides evidence of an increasing emphasis on information systems and the diversity of information being collected. Hopefully, with improved data collection and analysis and better use of IS/IT, the quality of information for planning and decision making will be greatly enhanced.

Clearly, the increasing ease of use of computer packages and the availability of microcomputers have encouraged IS/IT applications in the countries reviewed. The number of IS/IT projects seems certain to increase in future with more access to information and as new information services such as electronic messaging become cheaper.

NOTES

1/ Michael Batty, "Working Paper" (Prepared for the Unesco Meeting of Experts on Information for Planning and Decision-Making, Beijing, 10-14 December 1990).

2/ Organisation for Economic Co-operation and Development (OECD), *Information Technology and New Growth Opportunities* (Information computer communications policy, 19)(Paris, 1989), p. 11.

3/ See the conclusions and recommendations of the UNCRD-Universiti Brunei Darussalam Seminar, 22-25 April 1992.

4/ Jacub Rais and Paul Suharto, "Land Resource Evaluation and Planning Project: A Geographic Information System Application for Regional Planning in Indonesia," *Regional Development Dialogue (RDD)* 11 (Autumn 1990).

5/ "Personality Profile: Ricardo T. Biña," *Philippine Remote Sensing Newsletter* 2 (July 1991): 11-12; and various NAMRIA brochures.

6/ See the LREIS brochure; see also He Jianbang, "GIS Project for Regional Planning in the Loess Plateau of China" (Paper presented at the Malaysia-UNCRD International Expert Group Meeting on Regional Planning in the 1990s: Using and Managing Geographic Information, Kuala Lumpur, 24-28 September 1990); and his "GIS Developments in China -- From Past to the Future" (Paper presented at the Unesco Meeting of Experts, Beijing, 10-14 December 1990).

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41/ For example, the Malaysian National Institute of Public Administration (INTAN) recently set up an Open Systems Training Laboratory to serve "as the training facility for the public sector in Malaysia and as a showcase for heterogeneous computing". See *AMCB*, 22 (March-April 1992): 8, quoting from the *Computerworld*.