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<td><strong>Author(s)</strong></td>
<td>Zaris, Roslan.</td>
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Development Of An Urban And Regional Planning Information System: A Case Study

By

Roslan Zaris
DEVELOPMENT OF AN URBAN AND
REGIONAL PLANNING INFORMATION SYSTEM:
A CASE STUDY

by

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This paper is prepared for the Expert Group Meeting
on Integrating Information Systems/Technology
in local/Regional Development Planning
Singapore 31 Oct - 4 Nov 88
This paper reaches its final form assisted by Mr. Ir. Dading Sugandhi who has been working on hardware and software development and Mr. P. Gardiner who is working as an advisor to our Directorate, and I wish to acknowledge their contribution to this paper.

Roslan Zaris
Title: The DTKTD Urban Planning Database and Information System: A Case Study of Factors in Information System Implementation in Indonesia.

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Abstract
The case study will focus on the continuing work to develop and institutionalize an urban planning database and information system within The Directorate of Urban and Regional Planning (DTKTD), Department of Public Works. The basis for this system was established through the extensive urban and regional data collected under The National Urban Development Strategy (NUDS) Project which was located in DTKTD. This project accumulated information on a number of substantive topics (population, social economy, physical environment, infrastructure, etc.) and for a number of different levels of aggregation (province, district, sub-district, etc.). It also included creation of a special database for some 500 "strategic" urban areas which the project attempted to define in functional, as opposed to purely administrative terms.

Following the completion of NUDS at the end of 1985, these data and the computer (VAX 1107) on which they were stored, were turned over to DTKTD. This formed the basis for the continuing efforts to be described in this case study to develop a more comprehensive and integrated data storage and retrieval system which would meet the operational needs of users within DTKTD as well as of other potential outside users.

The main objective was to develop an hierarchical series of geographic data files with a common overall structure along with
associated software which would permit easy user access while maintaining the integrity of the overall system. A key concern was the need to link data storage and organization on the existing VAX minicomputer with data use and application which would, as the system developed, be carried out largely on micro-computers spread throughout the Directorate.

The technical strategy to accomplish this objective involved the installation of a networking system (Ethernet) along with associated software which would permit direct communication between the VAX and related micro-computers (largely IBM-PC or PC clone). Within the VAX itself it involved development of software to define and store data in a common file structure (defined, in this case, by level of aggregation, reference year, substantive topic and variable), along with user-oriented software to allow users to query the data base to find out what was available, to select specific data required for particular applications and, if desired, to download the data into standard data base or spread sheet format on their own micros.

To fit the decentralized nature of operations, a decentralized management and manpower structure was also designed. Although this has yet to be fully implemented, the idea is to create a central core headed by an EDP Manager who would be responsible for the major hardware (including the VAX and network), for software development related to the data base and centralized applications, and for day to day management of operations including user access regulation. Alongside the EDP Manager would be a Data Manager who would have overall responsibility for data base content, for the selection of data sources (largely secondary data from censuses and surveys, along with administrative and programme statistics) and for establishing and implementing procedures for file updating and expansion.

There would also be a small core staff of operators, programmers, data entry staff, etc. in the central unit; but a major effort would focus on duplicating many of these skills in the more localized units represented by user groups and centered around the clusters of micro-computers used in these units. These user groups would be responsible for their own equipment and applications and would share responsibility for updating data in the central system. In this respect, the core management plays both a direct supervisory and a more loose coordinating role.

Training efforts, which continue to be conducted periodically, are linked to this technical and operational design. While there is an effort to develop a small group of more highly skilled programmers and operators, the main efforts are aimed at basic skills required by users to interface with the VAX (either from VAX terminals or micros) and in expanding general micro-based computer literacy (use of packaged software) as this is seen as a means of broadening the user base and, hence, of stimulating demand on the overall system.
Implementation has focussed initially on installation of hardware, on software development and on the basic training noted above. Work has also been carried out on manipulation of several large-scale secondary data sets (for example, periodic survey data on Indonesia's 68,000 villages collected by the Central Bureau of Statistics) into the appropriate file structure and format. This represents, in effect, a path of least resistance since these activities can be carried out by a relatively small care staff and do not require major financial, administrative or emotional commitment from the larger organization.

As is the case with many information systems, implementation of a broader administrative/management structure and of stimulating active user involvement (a pre-condition for a viable information system) has been more problematic. There are a number of roots to these problems including a general lack of experience with operation and management of data bases and/or information systems and difficulties in getting such a system adequately financed within an essentially 'project oriented' funding environment. In the context of the universe of potential users, these issues go beyond DTKTD itself and involve the management and application of urban information as applied in a broader framework for integrated programming and provision of basic urban infrastructure (water supply, sanitation, roads, etc.) throughout Indonesia. The implications for this effort, known as the Integrated Urban Infrastructure Development Programme (IUIDP), will also be dealt with in the context of this case study.

Finally, these are issues of data credibility and of data application. Although there is widespread agreement on the need for up to date quality information there is less agreement on what information actually fulfils these criteria. There are also difficulties in quantifying specific applications on procedures required to produce information in a form of direct use to planning, programming and management decision making in general. Since it is the applications which should play a major determining role in system design and user orientation (as well as influencing data requirements), this concern is one requiring particular attention in further development of the system.
I. INTRODUCTION

Indonesia, in recent years has embarked on an ambitious program to decentralize the planning, programming and implementation of urban infrastructure development under the Integrated Urban Infrastructure Development Program (IUIDP). To coordinate IUIDP among several government departments, an inter-ministerial urban development coordination team (Tim Koordinasi Pembangunan Perkotaan, or TKPP) has been established. Among other things, this team has responsibility for coordinating the development of appropriate guidelines and procedures for local governments, while ensuring that the overall investment program continues to meet national development guidelines and five-year plans.

Meeting the variety of needs of such an undertaking requires a large amount of information. This not only includes information necessary to understand the process and directions of urban growth and development, but also information necessary for informed decision-making on basic priorities for urban sector investment, by region of the country, by size-class of city, and by infrastructure sub-sector. Ultimately, information is also required on program and project implementation, in order to monitor progress and to evaluate results in terms of broader national and regional development goals.

While work has progressed on the development of data bases and information systems to meet all of the above requirements, this work has remained somewhat fragmented both in terms of the range of applications (for example, as in the development of geographic data bases or project management systems), and in terms of substantive coverage (for example, as in terms of substantive orientation toward physical, institutional or financial planning). In large part, this fragmentation has been a result of the spread of institutional responsibilities for specific aspects of urban and regional development among different government agencies and of lines of communication which make vertical control (within specific government departments) much stronger than horizontal lines of communication between institutions at the same level of government.

Given this situation, this case study will focus on only a part of this overall problem, that of spatial planning, and, in particular, on work being carried out within a single Directorate, the Directorate of Urban and Regional Planning (DTKTD) in the Directorate General of Human Settlements, Department of Public Works, which has focused on the development of data specifically oriented toward urban and regional planning and which has included a major emphasis on data for policy and macro-programming purposes for defined "functional" urban areas within the country.
II. ORIGIN OF THE INFORMATION SYSTEM

The origin of the information system described in this case study can be traced to the early 1980s when the Indonesian Government with the assistance of UNDP/UNCHS initiated a major study to establish a National Urban Development Strategy (NUDS). This project had three major operational objectives:

a. To develop improved policies to address the key elements of national spatial planning.

b. To formulate an integrated national urban development strategy.

c. To establish a continuing institutional framework for updating and implementing the strategy.

While the first two objectives demanded the collection and compilation of a wide range of urban data, the last objective, if it was to be met, demanded the establishment of an appropriate organizational structure as well as an information system that would support the implementation of the strategy as well as any modifications that might prove necessary with the passage of time.

Unfortunately, the project itself was unable to meet its last objective, even though a data base on some 500 cities and towns defined by the project as "Strategic Urban Areas" was implemented during the closing stages of the project. A follow-on project to "institutionalize" NUDS also met with limited success largely due to a reluctance on the part of Government to adopt the strategy as an overall process. Rather, there was a tendency to adopt specific elements of the strategy where they were seen as useful or relevant to particular planning and programming applications.

This meant, in turn, that interest in data or in further development of information systems has also largely revolved around more specific process oriented or sectorial interests. Within the Directorate of Urban and Regional Planning (DTKTD) this was largely interpreted as a need for easy access to a relatively comprehensive range of planning information quantified at various administrative levels and as specified in guidelines and regulations for the preparation of specific types of urban and regional plans.

Beyond the regulated planning sphere, the NUDS project also served to establish a degree of credibility within DTKTD as a source of basic data for the development of spatial policy. This has resulted in a number of more or less ad hoc applications - for example, urban population estimates and projections, which have been fairly widely utilized by clients outside the Directorate (see below). While these efforts have gone some way
toward fostering acceptance of the information developed through the NUDS project and in subsequent work within DTKTD, in and of itself, it has done little to strengthen organizational capability to manage a relatively complex data system.
III. OBJECTIVES

The basic objectives of the urban and regional planning information system are largely reflective of the general needs expressed above. In terms of technical objectives, these can be expressed as follows:

a. To increase the overall efficiency in the organization and maintenance of raw data as input to various urban and regional policy and planning applications.

b. To reduce unnecessary overlapping in collection and storage of similar types of information by various users.

c. To accelerate the process of use of commonly agreed upon sets of information (in principle, the most reliable information available) for essentially similar applications among various users.

d. To develop effective systems for data classification (e.g. file structure, coding) that would provide a clear operational framework for user access and which would follow a format generally acceptable to a variety of users.

e. To facilitate the process of timely updating of various data within the system.

Besides these more technical concerns, there are also strong institutional development objectives involved. In particular, is the concern with development of an overall institutional capability within DTKTD to organize and manipulate data on electronic media, something which is likely to be best accomplished through the establishment of a central Data Processing Unit within the Directorate that would be responsible for the overall operation and management of the information system. Such a unit, however, would not only require the capability to internalize and manage the data base created by NUDS, but would also require the capability to expand the base over time in accordance with demand.
IV. SCOPE AND COVERAGE

The formal planning process in Indonesia is hierarchical and extends from the national level (as reflected in the national sectorial five-year plans or Repelita) down to statutory plans for relatively small towns and administrative centers. In between are various regional plans at the province, and regency/municipality (kabupaten/kotamadya) levels. This applies both to sectorial programming as epitomized by the Repelita process, as well as to the more continuous process of preparation, evaluation and updating of strategic and spatial development plans at various levels of geographic aggregation.

It should be noted that responsibility for spatial planning rests with the level of government concerned. Provinces are thus responsible for preparation of provincial plans, and second level regional governments (kabupaten/kotamadya) for plan preparation for regencies or municipalities. In this sense, they are also responsible for the information used in the planning process. The problem, however, remains one of communication. Information is collected at a variety of levels and, in many cases, information useful to one level of government is collected or maintained by another level of government. Even where simultaneous collection takes place, different sources or data collection methods often lead to conflicting results.

In any case, it can easily be seen that solving these problems in a coordinated manner still ultimately requires a relatively wide variety of information classified by several levels of administrative area. In terms of the various levels of planning this means data classified by the main administrative units - by province, by regency/municipality, by district (kecamatan) and by urban or rural village (kelurahan or desa). The NUDS experience also indicated the need for classification of data according to functional urban areas (basically groups of urban villages) which, however, need not conform to the boundaries of any of the higher level administrative areas indicated above.

The scope of planning is also very wide. Even the structure planning process which defines most of the work in which DTKTD is involved encompasses a variety of economic, social, spatial and institutional sectors. In several respects, this breadth of scope itself created problems in implementing a program for system development. This is because, unlike the coverage base, which can be more or less clearly defined and which is largely consistent with standard approaches to data collection by administrative area, the scope of information required (in terms of the specific types of data and indicators required for sectorial analysis) is, in fact, quite difficult to define.
In dealing with issues of scope, the core of an approach likely lies with the orientation of such a system to outputs. In principle, to avoid an unmanageable situation in which data acquisition is more or less random, there is a need to carefully define inputs in terms of specific applications and outputs (possible planning or policy decisions). But even here, in many cases the applications or outputs themselves are not obvious, and even where they can be generalized, there is still likely to be substantial regional variation that itself implies different sets of priorities as to the specific types of data, or depth of information, required to address particular development issues.

This, along with problems of staff constraints, has resulted in a conscious decision to structure development of the information system as a more limited series of steps, focusing on specific data sets or planning issues, and trying to build elements of a system which can, at a later stage, be integrated into the broader framework (in terms of scope and coverage) indicated above. Specific activities and problems encountered in this approach to system development are dealt with in greater detail below.
V. ORGANIZATIONAL AND MANPOWER RESOURCE PLAN

A. Organizational Structure

System organization is designed to maximize the role of users as well as existing hardware. In principle, it rejects the idea of a closed centralized operation in which end users are dependent on central computer staff, for an organization which emphasizes direct user interaction. This is because, even though the general nature of information that is likely to be required can be specified with some degree of accuracy, specific applications will frequently vary depending on local conditions. Some applications will also require intensive user interaction with the data base (as in simulation or projection exercises). Such a decentralized approach is facilitated by the rapid technological change in desktop systems which now permit small compact individual work stations to rival the capacity and speed of mainframes only a few years ago. In short, the technological (and cost) limitations on allowing individuals to maintain and manipulate relatively large amounts of information are rapidly becoming a thing of the past.

The key issue, then, is an organizational structure which maximizes overall efficiency; even where this adds a level of complexity to system management and control. In this case, a "two-tiered" structure has been proposed in which a central "common" data resource is shared among a number of users who can draw on this common base and then augment it with additional information relevant to their specific needs. The result is thus not one, but several more or less distinct information systems maintained at different levels and, depending on user preferences, potentially incorporating a variety of storage mediums and oriented toward a variety of user-defined or package software.

Thus, at least in its early stages, the system is largely seen as a way of effectively sharing types of information that were previously largely collected and processed independently by various users. The basic pattern of information flow implied by this type of approach is indicated in Figure 1. Under this framework, responsibility for collecting information is shared. The Central Data Processing or Central Systems Unit is heavily involved in information collection, but it can also draw on materials compiled and maintained as part of the normal work of users or participating units. The integrity of the central data base is ensured through control of the data input process. Information may be obtained via users, but they do not have the right to actually input that data or alter the structure of the central system.
A similar degree of flexibility is maintained relative to outputs. Given that a generalized data base/information system is unlikely to ever be "complete" in that it will be able to answer all questions for all users, users will still need to be involved in data collection and analysis. The information system as envisioned here is largely seen as a support to those efforts, through the efficient and timely provision of raw data to be processed by users, or, where relevant, the provision of processed outputs according to agreed upon formats that can be directly used in the urban/regional planning and management process.

One view of an optimal organizational structure to meet these needs would involve a distinct Central Systems Unit operating under the office of the Director of DTKTD and which would be linked as a service unit to the operational (planning) Sub-directorates, and, potentially, to other outside users. At the present time, however, it has not been possible to give such a unit this high a level of status and the "home base" of the DTKTD information system development effort is currently subsumed under the Sub-directorate of Planning Support Services (Turbin), and within this Sub-directorate, under the Section for Information and Mapping.

This is actually less of an organizational structure problem (since the Information and Mapping Section has the functional mandate to operate according to the pattern suggested in Figure 1) than a problem of organizational status since the skills required (see V. B. below) have proven to be difficult to obtain with information system development assigned a relatively low level within the status hierarchy. This situation is indicated in Figure 2, which shows the organizational structure as currently envisioned, and in Table 1 which indicates some of the activities involved. It should be noted that this structure has not yet been fully implemented (formal assignments to several positions have yet to be made). However, all of these functions are more or less being carried out, either by Directorate staff or by consultants.

1. There are four operational Sub-directorates in DTKTD - one for general regional planning (national/province level), one for sub-regional planning (district/sub-district level) and two for urban planning covering the Eastern and Western parts of the country. There is also a fifth Sub-directorate (Turbin) which is engaged in a variety of support activities including information processing and management.
B. Resource Needs

1. Manpower Skills and Resources

The organizational structure given in Figure 2, and elaborated in Table 1, indicates the types of skills required. While virtually all of these skills remain in short supply within DTKTD, the general view taken has been that development of a viable (e.g. self-sustaining) system primarily depends on the early recruitment/appointment of suitably motivated and qualified people to the two key positions of Data Development Manager and Systems Development Manager. Other outstanding functions could then be filled gradually through recruitment or training as needs required.

The major concern in this area has undoubtedly focused on the position of Data Development Manager. Unlike many operational systems where inputs and procedures can be clearly specified, the development of an information system for urban and regional planning and management has been seen as being a largely open-ended problem, with decisions on data development focusing on mating objective views of information supply and demand in an effective manner. This means that far from simply implementing or updating a prescribed set of data, data development in this situation implies a rather complex process of definition, selection, and evaluation of various types of information, generally as related to specific applications involved in the planning process. Development or recruitment of sufficient skill in this area is thus seen as critical to the overall manpower development process.

2. Budget and Financial Resources

Budgeting and financing of information work is carried out within the normal operating framework of DTKTD. This includes the routine budget allocations (largely for staff salaries and overheads) and project budget allocations for specific development programs, including foreign technical assistance budgets which can be utilized for purchases of equipment to upgrade the system. Limited cost-recovery is also being implemented through application of user charges (computer time, paper, etc.) for the production of specific outputs. These charges are, however, purposely being limited to users outside the Directorate (and primarily to foreign consultant contractors) in order not to dampen development of demand among potential domestic users.
The point to be made here is that there is currently very little independence in the financing of information system development in DTKTD. Given the availability of project funds and the limitations on the pace of development, this has not proven to be a major constraint (although it has led to delays in funding data acquisition). However, with increasing demands, it may become an increasing problem in the future, demanding greater attention to cost-recovery and more innovative methods of financing system development.

C. The End-User’s Role

As noted earlier, the end-user’s role is instrumental to the sustainability of the system. Without a dynamic interaction between systems staff and users, the system will invariably go the way of other such general data bases in the past — deteriorating into a static, unproductive set of information which will lack credibility and, hence, rapidly fall into disuse. Furthermore, it is the end-users who essentially are the analysts, and it is thus they who, at least in theory, need to pose the questions which can be used to establish the basic output-oriented framework within which the information system must operate.

In practice, this is accomplished by emphasizing the importance of “user relations” and the role of various users and user-groups within the overall organization. The diagram at the bottom of Figure 2 indicates the “ideal” situation in which there are smaller, but complimentary, data processing units within each Sub-directorate of DTKTD. These units, along with such similar units as may be defined by potential clients outside the Directorate, form the core of this interactive process. While the full structure envisioned in the diagram has not yet been implemented, each of the operational Sub-directorates already has a Section concerned with the provision of base data for the Sub-directorate’s planning activities and several Sub-directorates have moved further to develop internally, the hardware and computer skills necessary to effective user interaction within such an overall framework.

D. The Role of Data Processing Specialists

Interestingly, in Indonesia, the problem is often not one of lack of information, but of information which, because of the way it is maintained or stored, is largely inaccessible to users. The obvious case is with large scale data sets stored on magnetic tape which, due to various constraints, have only been partially exploited (in terms of published
outputs) by the responsible agencies. The ability to acquire data sets of this type and carry out further processing can thus lead to major improvements in information at a relatively limited cost (at least if one considers the cost of new data collection efforts).

To give an example, the Indonesian Central Bureau of Statistics carries out a periodic survey of all villages (desa) in Indonesia (known as the Village Potential Survey or PODES), collecting a variety of information on village characteristics. None of this is formally published, and, although much of this information is subject to severe questions as to reliability and validity, it remains the only systematic national source of data at this level of administrative aggregation. Careful use of these data can thus be of significant assistance to urban and regional planning activities. Yet, without the availability of data processing specialists to organize the information in ways that can be directly applied by users, the ability to exploit these data will remain limited indeed.

Difficulties of interagency communication and often wide variations in agency needs mean that high level centralization of these skills is also not generally feasible. Each agency, with, in this case, agencies being defined in terms of relatively compact sets of objectives and tasks, will need to develop data processing skills to a relatively high degree of sophistication. In this regard, DTKTD is no exception.
Figure 1 - Pattern of Information Flow: DTKTD Urban/Regional Planning Information System

Information Source → User #1 → Data Processing → Planning Results

Information Source → User #2 → Data Processing → Planning Results

Information Source → User #3 → Data Processing → Planning Results

Information Source → Central Information System Unit

Information Source → User #4 → Data Processing → Planning Results

Information Source → User #5 → Data Processing → Planning Results

... (Dashed lines indicate omitted users)

Information Source → User #n → Data Processing → Planning Results
Figure 2 - Organizational Structure of Information Systems Unit

Directorate of Urban and Regional Planning

Sub-Directorate of Planning Support Services

Section for Information and Mapping

Electronic Data Processing Unit (New)

Administration

Data Management

Data Input

Data Verification

Documentation

Applications

User Relations

System Development Management

Systems Development

Programming

Computer Development

System Operation

Sub-Directorate

Section for Information Processing

Research

Analysis

Programming

Punching
Table 1 - Functions Required for DTKTD Urban/Regional Planning Information System

1. **Administration** - initial processing of user requests, reporting on status of system usage/user accounts, invoicing, dissemination of output, etc.

2. **Data Management** - definition of data requirements, definition of data sources and organization, data collection, input and verification, data maintenance and updating, documentation, etc.
   a. **Input** - data entry (mainly punching, but can also include coding, data transcription, etc.)
   b. **Verification** - checking of source materials, inputs to the system and outputs.
   c. **Documentation** - preparation of manuals, directories, inventories, etc.
   d. **Applications** - selection and/or specification of software applications.
   e. **User Relations** - active liaison with users regarding data and applications available, assessment of user demand as input to further system development.

3. **System Development** - management of existing hardware and software and design and implementation of systems extensions, management of systems usage including scheduling of data processing activities and day-to-day operations.
   a. **Systems Development** - software design and implementation, including data management systems and applications.
   b. **Computer Development** - hardware management and upgrading, including increasing compatibility of user systems with the Central Unit.
   c. **Programming** - technical programming support for development of data management systems and applications.
   d. **System Operation** - computer operation, including management of time utilization for special projects and day-to-day operations.
VI. TECHNICAL STRATEGY

A. Applications Required by Time Phase

Under the rather loosely defined system of data definition implied by this type of operation, and because systems and procedures for urban and regional planning and management are themselves being changed and upgraded over time, it is difficult to define a step-by-step time dependent process for development of applications. Rather, applications have, and will likely continue to be determined on a more or less ad hoc basis and will then be internalized as "output-oriented" objectives for system development.

For example, the most critical concern for NUDS and a major concern for urban planning and programming generally, was for the need for a spatial-demographic data base (with forecasts and key development indicators) for urban areas throughout the country. This was the underlying rationale for creation of the NUDS Strategic Urban Area File covering the roughly 500 NUDS Strategic Urban Areas and containing, besides population projections, a range of development indicators, including those related to development status (existing social and economic conditions, levels of infrastructure development, etc.) and to development potential, both in terms of positive factors (e.g. industrial development potential) and negative factors (e.g. environmental constraints).

Since the completion of the NUDS project, efforts at system development have continued to focus on national-level applications which require a quantitative framework for either the broad macro-programming of resources or for the evaluation of proposed projects. The following list gives some idea of the range of applications that have been worked on so far:

a. Estimation and projection of urban population by region (province) and city.

b. Analysis and projection of infrastructure development priorities by sub-sector, region and size class of city.²

2. The main emphasis here has been on sub-sectors of direct interest to IUIDP. These sub-sectors include water supply, human and solid waste management, local area (kampung) improvement, market area improvement, urban roads, and urban drainage.
c. Analysis of urban area characteristics and development indicators based on village level data from the PODES surveys as a basis for studying general processes of urban development and change.

in practice, this also means that client orientation in applications development has generally been toward Central Government - toward DTKTD and, outside this organization, to IUIDP and TKPP. An inherent concern of the system, however, has, from the beginning, been toward urban and regional planning carried out by lower levels of government. It is expected that greater attention will need to be given to applications in this area in the future if the system is to reach its full potential.

B. Data Base Development and Management

The technical strategy for data base development has, at least in principle, being built around several key premises.

a. The data have to be stored in relatively small files that can be easily down-loaded to PC type computers by users.

b. The data have to stored in a compact structure in order to prevent a wastage of storage space due to incomplete data for certain regions or variables.

c. The data have to be stored relationally so that file structures can be revised easily and quickly.

d. The data have to be stored in a special directory which is distinct from any "working area" assigned to individual users.

e. The data have to be easily accessible to users, including those who are not highly familiar with computers.

In view of these basic premises, an attempt has been made to develop an in-house "Common Data Base" architecture to meet these objectives. The basis of this is a file structure denominated according to three basic criteria - substantive topic, time period, and geographic location. These criteria are coded according to a fixed structure and these codes then become the identifiers for particular files. Records within each file refer to the specific administrative units immediately below the level indicated in the file reference. For example, the data file for land use information in 1985 in the regency (kabupaten) of Bandung in the province of West Java might be coded:
CDB138532206.DAT

where: CDB = a prefix identifying the Common Data Base
       13 = the substantive topic code for land use
       85 = the year to which the data refer
       32 = the code for the province of West Java
       06 = the code for the regency of Bandung
       DAT = extension label for data

The file would then contain a series of fixed length records
of information on land use for each of the next lower level
administrative units (districts or kecama­tan) within the
regency of Bandung. The formats and variables stored in
these records would be identified in an on-line data direc­
tory so that individual users could clearly see what infor­
man­tion was available. Software has been developed not only
to allow users to query the data directories, but also to
allow them to extract selected variables within files and to
print the information (hard copy) or to download the data
directly to their own computers via a network (see below).

This approach was seen as a vehicle for developing a sys­
tematically defined data base that could be utilized for a
variety of applications. Unfortunately, full implementation
of this approach has proven difficult due to limitations on
staff within the Data Processing Unit and due to dif­
ficulties in developing a user awareness or mentality to
take an active interest in pushing the more difficult task
of building files with appropriate types of information.
This has meant that while data development has progressed on
a more ad hoc basis through the implementation of specific
applications (see VI. A. above), there has been only limited
progress toward formally integrating these data into a true
information system framework.

C. Sources of Data and Information Flows

1. Sources of Data

Priorities in data acquisition have so far been defined
based on two criteria; user requirements and the nature
of the source material. In the first place, efficiency
is enhanced if data likely to be of use to a relatively
large number of users are centrally maintained.
Secondly, data from relatively large-scale operations
(e.g. censuses, major surveys) - particularly where
these are transmitted in machine readable form or where
extensive reorganization or segmentation of data is re­
quired - are likely better handled by a central
processing group.
In this sense, the major concern has been with large data sets compiled by the Indonesian Central Bureau of Statistics (BPS). BPS has been assigned the primary role by government for the collection and initial processing of major census and survey data across a wide variety of sectors. This work is complimented by a range of administrative data collected by various sectorial agencies. Some of this secondary data is also published by BPS.

The NUDS project drew heavily on BPS data, particularly the 1980 Population Census and various Industrial Surveys (medium and large scale industry). Some work was also carried out using the first PODES survey, also conducted in 1980. Data from subsequent PODES surveys (1983, 1986) have also been obtained on magnetic tape since the completion of NUDS and structured and documented so as to be amenable to further applications. The NUDS project also drew on other secondary data, for example, land use data collected by the Directorate General of Agraria in the Department of Home Affairs, and data on internal goods flows from Origin-Destination Surveys carried out by The Departments of Public Works and Communications.

The variety of data sources that need to be consulted points out the rather fragmented nature of data collection. This poses not only problems of data access, but also problems of data compatibility since most of these Departments follow different procedures in the field. Building a multi-sectorial data base such as is required for urban and regional planning thus confronts the analyst with pertinent questions regarding data reliability and validity both in terms of base sources for those data and in comparison with other sources used in constructing the data base. This is a particular problem where similar items of information (e.g. population) are collected and reported in a variety of sources. This provides a clear demonstration of the earlier emphasis on data evaluative skills (the role of Data Development Manager) in building an information system of this type.

2. Information Flows

The nature of information flows have been briefly alluded to earlier and are shown in Figure 1. In principle, Figure 1 shows that inputs can be derived either from sources (publications, magnetic tapes) acquired by the Data Processing Unit or by the transfer of data already compiled in a data base format by users. Outputs can be handled in a similar fashion, either by direct
transfer (generally via diskette) of raw data back to users or through the provision of processed outputs (tables of indicators, output from applications) based on specific user requests.

In practice, as might be expected, the exploitation of the data base so far has largely been carried out by Data Processing Unit staff in accordance with requests raised by users and with processed output provided in the form of hard copy or diskette. In some cases, however, raw data has also been provided where users have wanted to access particular information in building their own applications. An example has been the use of environmental indicators (rainfall, ground water availability, slope data, etc.) in analyzing needs for urban infrastructure development at a regional level.

D. Technical Architecture

The strategy for hardware development has generally tried to follow the strategy for information flow described above. This has been constrained, to a degree, within DTKTD by the need to maximize use of existing hardware which includes a centrally located VAX 11/730 mini computer system and a number of micro computers (generally IBM-PC clones) in the various Sub-directorates. The basic principle guiding hardware development has been the need to maintain the independent analytical capacity within each Sub-directorate while allowing them ready access to the central data files and applications held on the VAX.

The accepted strategy involves networking (see Figure 3) using an Ethernet Communications System which is compatible both with the VAX operating system and with IBM-PC DOS. This approach allows the micro computers within each Sub-directorate to be used either as completely independent work stations or as smart terminals for the VAX. Users can thus use their own computers to draw specific information down from the VAX to their own storage areas for further processing or to run applications directly on the VAX using work space assigned to the user by the Central Processing Unit management. This option is particularly useful because different applications will run more effectively on different hardware. For example, most users in DTKTD are familiar with standard spread sheet/data base software for micro computers. Some applications, however, such as population projection programs, have been written in Fortran and are thus easier to run on the VAX with output being provided in hard copy from the VAX printer or transferred to floppy diskette.
Software development is also geared to these two levels of operation. In regard to the VAX, the attempt to develop a "Common Data Base" architecture has been alluded to above. Other software development on the VAX has been largely determined by applications, for example, software for population analysis and projection, software for analysis of infrastructure development priorities at the regional level, and software for the restructuring of large data sets such as PODES and creating special subfiles for specific planning applications. Although not yet implemented due to cost, consideration is being given to general statistical software packages, particularly those oriented toward graphic and cartographic forms of output.

E. Distribution of Computers, Files and Processes

Figure 3 also shows the pattern of hardware distribution between the Computer Center and Sub-directorates within DTKTD. The implication of this arrangement is that files and processes can also be held at either level, with considerations of feasibility and efficiency determining the most appropriate configuration. Admittedly this does imply a degree of duplication, although given the relatively low cost of storage, this is not seen to be a major constraint.

Maintaining the integrity of various files and processes is handled, at least on the VAX, by the use of various levels of file protection and user priorities with regard to access and ability to modify specific files. Thus, with regard to most users, the main data files, as well as some output files which are likely to be of fairly widespread use are held in read only format so that users can have access, but cannot directly alter the base files. Of course, they can be copied and the copies altered or restructured according to a particular user's needs.

F. Provision of Users Manuals

Users manuals have been created for the NUDS Strategic Urban Area Files and for the "Common Data Base" architecture noted earlier in this discussion. In addition, a library of manuals for specific "package" software is maintained and made available to users. Where possible, questionnaires or codebooks from major survey data sets (such as PODES) are also held. Although these are not the same as user manuals, they can be used in identifying what information is available and in preparing specific requests for information to be extracted from these sources by Central Processing Unit staff.
Figure 3 - Computer Network Development Within DTKTD

Sub-Directorate #1

- IBM-PC
- Local Printer

Sub-Directorate #2

- IBM-PC
- Local Printer

Et cetera.
VII. IMPLEMENTATION PLAN AND STRATEGY

A. Implementation Plan

The original implementation plan was expressed in a series of consultant reports prepared during the NUDS project. These basically recommended a more or less sequential process of organizational development (establishment of a Central Processing Unit), hardware and software development (expanding the VAX capacity, adding peripheral equipment including scanners and plotters, acquiring relational data base software, etc.), establishment of basic file and code structures for data organization, and a gradual process of building the actual data base while, at the same time undertaking intensive manpower development, both of central staff and of potential users.

Initially, the core of the work was supposed to center around the information collected during the NUDS project (e.g. urban indicators and forecasts), although, as noted in the beginning of this case study, this was subsequently modified to focus more generally on data for urban and regional planning as carried out within DTKTD and on urban data oriented to the specific policy and programming demands of IUIDP and TKPP. This revised approach was rationalized in a subsequent Working Paper prepared by a DTKTD Working Group which proposed the Common Data Base architecture and the overall management and organization structure discussed earlier in this case study.

Since the completion of that Working Paper, some further modifications in the plan have occurred, largely dictated by the difficulties encountered in implementing the Common Data Base architecture as proposed. In practice, this has meant a shift from a system building focus (organizational, software, etc.) to an applications focus (outputs) in order to develop a greater credibility and awareness among users of how the information can be actually be utilized.

B. Strategy for Implementation

One observation from this gradual shift in focus of the implementation plan, relates to the difficulty of institutionalizing a "data orientation" or "data mentality" among system users. Admittedly, this is not a necessary criteria of an information system which can be designed to provide prescribed outputs that can be applied essentially verbatim by users in their work. On the other hand, this kind of approach is less likely to develop strong user-system linkages which are seen to be critical in what is viewed here as a process of more effective exploitation of existing data through innovative processes and applications.
This, as noted in VII. A. above, has affected the implementation strategy to the degree that available staff time has been oriented toward the internal development of specific outputs, rather than the continuing development of user-oriented systems. On the one hand, this has slowed down information systems development in DTKTD. On the other hand, because the issues or requirements are still, to a large degree, user defined, it has, on a more or less ad hoc basis, led to the production of outputs which meet defined objectives in the planning field. In this sense, it has been the development of applications, rather than the data itself, which has been the critical factor in determining the degree of success so far achieved.

Using the PODES data as an example, an effort is currently being made to develop a framework linking all villages designated as urban within the PODES file structure to the functional urban areas defined by NUDS. The 1980 PODES was, in fact, used by NUDS to define functional urban areas, but the project finished before subsequent PODES surveys (1983, 1986) could be used to update this framework. The final output will thus be a time series of data on population and other characteristics at the village level which is formally linked to the urban definitional framework of NUDS and which, furthermore, accounts for changes in urban areas (due to changes in the urban status of individual villages) over time. In many respects this type of output, which can still, in principle, be further manipulated by users, is currently seen to be of greater practical significance than attempts to organize the raw data within a relational data base structure such as that defined by the Common Data Base architecture described earlier.

C. Problems Encountered in Implementation

Many of the problems encountered in attempting to implement an information system for urban and regional planning have been mentioned above. In summary, although not necessarily in order of importance, these include problems related to organization and staffing:

a. The lack of status accorded to information systems development within DTKTD.

b. The resultant lack of a sufficient volume of sufficiently qualified staff to implement the system.

c. The specific difficulty of filling the position of Data Development Manager.

as well as problems related to user relations:
a. The general lack of a "data orientation" among users.

b. The resultant lack of user support in implementing the Common Data Base architecture and multi-level organizational structure defined in the Working Paper.

The result of this, as noted above, is that the overall system development has remained at a relatively early stage, while work has focused, largely within a project environment, on the production of specific outputs or products.

D. Management and Staff Training

One implication of the problems outlined above is that training or, more generally, manpower development, involves not only management and staff at the center, but also users. Furthermore, it involves not only technical training (e.g. how to relate to specific hardware and software), but, at least in this case, it also involves training in how to approach and use data in specific analytical applications. On this latter point, the concern is less with the actual analytical techniques as with an ability to select, evaluate and organize data stored in a variety of locations within an overall information system to meet specific analytical needs.

Limited training has been attempted. Outside training courses have been utilized to introduce staff in DTKTD Sub-directorates to basic elements of micro computer processing and major package programs (word-processing, spreadsheet, etc.). In-house training has been carried out to introduce Sub-directorate staff to the basic command structure and operation of the VAX 11/730 and in use of the Common Data Base. Central computer staff have been supported to attend outside seminars and workshops. This has led to some positive results, although it is to be expected that this aspect of system development will take some time to bear fruit and will depend not only on such formal training, but also on the gradual gaining of experience and development of a "computer mentality" among staff and users. In some cases it may also be necessary to focus recruitment efforts on skills in this area, an option which has been given only limited attention up to the present.
VIII. EVALUATION OF COSTS AND BENEFITS

In general, due to the currently limited size and scope of the information system, there is little that can be said at present about the formal costs and benefits. Given the fairly limited horizons, costs have not been a major factor. In terms of real expenditure, the major costs to date have related to hardware development (costs of the VAX 11/730 mini computer system) and costs of data acquisition where these have required the purchase of raw data files on magnetic tape. The former have largely been subsumed under foreign funded projects, although continuing maintenance and operational costs of equipment, which are not negligible, do have to be borne by DTKTD and are perhaps the major concern in terms of cost recovery.

Software development has primarily been carried out in-house and has so far avoided the purchase of relatively expensive commercial software packages. Manpower costs have either been subsumed under projects (through the provision of consultants) or have drawn on regular staff of the Directorate who are already supported through the normal departmental budget. Likewise, at least some of the overheads can be absorbed through similar means.

Benefits are also limited so far. It is safe to say that as a sustainable operation the system has not yet proved itself and probably will not do so for some time to come. On the other hand, specific outputs have obtained a degree of user acceptance, at least among key clients both within and outside the Directorate and this achievement can and is being used to justify continuing development.

Other benefits are either less tangible, or have yet to become tangible. Effectiveness and efficiency of the system, for example, has to some degree been proven by the internally developed outputs, but it has yet to be proven in terms of more intensive forms of user interaction (e.g. through networking). Networking is still considered as an optimal solution, but it is clear that until users become oriented and comfortable with working within such an environment, they will generally prefer to do most of their data acquisition and processing independently. It is possible that in such circumstances, efficiency may need to be improved in stages - first through more intensive use of personal micro computers by individual analysts (something which is already taking place as Sub-directorates acquire increasing amounts of equipment), and then through developing a user orientation toward a more highly integrated, centrally managed information system. It is likely only then that a proven competitive or comparative advantage will actually be perceived.
IX. IMPACTS OF THE INFORMATION SYSTEM

A. Major System Contributions to Agency Objectives

The information system as it has been developed to date has been able to make a contribution toward agency objectives through the provision of specific outputs which support the preparation of national spatial policy as well as the urban and regional planning process. Particular outputs such as urban population projections have led to a better understanding of urbanization trends. NUDS indicators for specific urban areas have been utilized in various sectorial analyses related to preparation of infrastructure development strategies for IUIDP. The work on the PODES data files is contributing to a better understanding of intra-urban conditions and patterns of growth. In all of these activities, staff are gaining an increasing understanding of the raw data and of ways to manipulate it to achieve specified objectives.

B. Role of the System in Decision Making and Planning

In this area the same applications have had at least a moderate impact on decision making and planning at the national level, while impacts at the more local level, for example, in the preparation of specific regional or urban plans, are largely yet to be realized. For example, the urban demographic data base has been used as a basis for defining per-capita objectives in urban infrastructure development within the national five-year planning framework. This is in spite of the fact that most local area planning, which is, in any case, the responsibility of local government, still continues to rely on local estimates derived from other sources.

There is, however, an increasing interest in further development of data for local and regional planning, and in finding the most appropriate systems for increasing levels of communication of key planning data and information between levels of government. System development so far, has concentrated primarily at the national level, so that this remains an important topic for future attention.

C. Nontechnical Impacts of the System

The basic psychological issue of developing a "computer" or "data mentality" among users has been mentioned as a concern in implementing a truly interactive data base or information system framework, and it seems safe to say that system development efforts so far have made only limited inroads in this area. Undoubtedly, this problem will, at least in part, be gradually overcome, if only because of the increas-
ing use of micro computers by staff within the Directorate. Information systems development can, however, support and accelerate this process to the degree that staff can be encouraged or even forced to interact with the information and data that the system holds. In fact, this has happened in a few cases already where users have been able to make use of existing data held on the VAX computer in their own applications, but a stronger commitment to user relations and user participation in the future might produce more widespread results.
X. CONCLUSIONS AND RECOMMENDATIONS

In conclusion it seems most appropriate to come back to the question of the utility of spending considerable time, effort and money developing large data base systems largely outside of a tightly structured framework of applications or outputs. Here we are not just talking about objectives, which can be much more broadly defined, but of specific procedures or forms of data organization, which can be directly applied (e.g. without additional data organization or manipulation) by users. If the applications take precedence, then this has strong implications for the way in which materials and data are organized within the system.

The experience here is that in an environment such as currently exists within DTKTD, if not more generally, at least in the early stages of development such an applications focus does need to take precedence. As noted earlier, such a focus is not without advantages as it does provide a more direct and tangible service to users who often are simply interested in having their questions answered, not in being given a set of inputs and a lengthy explanation of how to get there.

The most important recommendations reflect the problems discussed earlier in this case study. First is the need to raise the status of information systems development within the overall organization as a bias for attracting more qualified and motivated staff and to establish a greater organizational commitment to this type of work. This needs to be supplemented by a comprehensive manpower development strategy including provision for outside professional training (systems analysis, information science) at the undergraduate or post-graduate level for key staff.

Second is the need to find innovative ways to build a stronger and more sophisticated set of relations with users. In principle, this means finding ways to link not only the information but also user interaction with the system into the normal framework of user activities. One recommendation is, whenever possible, to include or write in information development as a part of ongoing projects and assign information systems technical staff (subject to time and manpower constraints) to project teams. It may also be relevant to approach this from the other side and specifically commit professional and technical resources among users to special applications projects designed to more generally exploit information held within the system. In principle, such efforts should be designed to develop among users a greater understanding or appreciation of the nature of data processing, if not to develop actual skills and confidence among users in using computer systems in their work.
Finally, is the need to focus greater attention on the data. The general conclusion is that hardware and software development is actually the easiest step in the information systems development process. Generally too little attention is paid to content—the numbers and letters that make up the information itself. Studies which focus on technical issues of data collection, data evaluation, the structuring of data within various storage media, and development of indicators are required in relation to specific planning issues. Some of these types of studies have or are being carried out, but more work in this area will be required if a credible information base that appeals to a sufficiently wide variety of users is to be achieved.