

# Land Use Information System for Local Government: The Case of Naga City, Philippines

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## ABSTRACT

This paper examines the context of land use planning and monitoring in local government. It reviews emerging trends in land use management and information system, and identifies issues and challenges facing Naga City local government in the Philippines.

The paper then proposes a design solution for an information system to support and manage land use processes. It defines the user requirements for the information system, and formulates the System Architecture, which identifies the essential components and processes, and their functional relationships.

The paper concludes by defining the implications of a land use information system for land use management and local governance.

**Keywords:** land use, information system and management, system architecture

## 1. INTRODUCTION

The word “land use” can mean different things to different people. For many, land use is synonymous to a map where the geo-space under study is divided and classified according to dominant use. For others, land use is more than a map output. It is a complex process that deals with allocating land and determining its use for sustainable development. It is very much a socio-political concern as it is economic and geographic. In the Philippines, land use refers both to the substantive issues of land conversion, land reform, environmental protection, agricultural productivity, land valuation, as well as to a map layer of a municipal information system or a fundamental dataset of a planned geo-spatial data infrastructure.

Local government in the Philippines looms large in the discussion of land use issues. With the enactment of the Local Government Code in 1991, the process of land use planning and monitoring falls squarely on the shoulder of local government. Local government is mandated to adopt a Comprehensive Land Use Plan (CLUP) and to enact a zoning ordinance. It approves and issues development permits, zoning clearances for building and business permits, and certificates of site zoning classification.

The day-to-day operation of Naga City local government in City Hall and its transactions with the public create, use, and re-use a considerable amount of data. A significant portion of these data deals with space and time. One estimate shows that more than 80% of the data needed by government, businesses, and private

individuals relate to the location of people, places, things, and events [6]. Thus, an information system that could handle both spatial and attribute data would be a valuable resource for local government.

This paper aims to provide local government with a tool for managing land use processes. The first two sections present the context of land use planning and monitoring. The first part discusses emerging trends in land use planning and information system. The second part examines the various issues and challenges facing Naga City local government. The third section proposes a system solution by defining user requirements and designing the System Architecture. The paper concludes by identifying the implications of a land use information system for local governance.

## 2. LAND USE AND INFORMATION SYSTEM

### Emerging Trends in Land Use Planning

Land use is defined as the “economic and cultural activities practiced upon the land” [2]. It is about the relationship of man to land and his action on this relationship. Land use, therefore, is viewed more as a process than an output. It is a dynamic concept denoting complex interaction and changes occurring over time.

Traditionally, the focus of land use planning has been on the physical aspect. That is, planning is done to carve out areas for agriculture, housing, industries, commerce, institutions, and so on. The tools commonly applied are comprehensive general plans, master plans, or strategic plans to promote certain land use pattern [10]. These plans, however, assume slow-growing cities and are found to be time-consuming, too detailed and costly...essentially static in nature, lacking effective land-use control mechanisms and investment priorities [10].

Out of the need to look into the issue of implementation, urban management becomes a major concern. This encompasses planning, resource allocation, and policy implementation [4]. Thus, issues on implementation and monitoring become salient. Planning now calls for continuous review and development of strategies for enforcement.

Monitoring becomes crucial as it deals with the actual implementation of plans. It allows local government to see trends and effects, to check progress, and to make necessary adjustments. An information system can support monitoring procedures as it provides current and changing patterns of land use in the area [2].

From physical planning to urban management, the focus now shifts toward urban governance [4]. This calls on government to build partnerships and to get various sectors involved in public affairs. Land use planning and monitoring should now find ways to genuinely involve people in planning the future use of land and in monitoring progress, or the lack of it.

### Developments in Information System

Information system has been narrowly defined in terms of databases. This definition focuses on data requirements and the mechanism to store, organize, process, and analyze data. An alternative definition takes on a broad perspective to encompass all components of the system, such as data, software and hardware, people, methods, and procedures.

A common concern in these definitions is the need to translate data into information that would contribute to achieving organizational goals and objectives. Thus, information system is popularly linked to concepts like Decision or Planning Support System.

Until recently, information system has evolved from an inward to more outward-looking perspective. The objective now is not only to support decision-making but also to meet the demands and satisfaction of users and clients. Organization is not seen solely as a decision-making system but more of an enterprise with a business purpose and a customer to satisfy [1].

Along with this development is the growing interest in Knowledge Management, which looks at how people in organizations use and process information. This brings into sharper focus the fact that people and not databases create knowledge. This also goes hand in hand with the changing concerns of information technology, that is, from data to information, and now to knowledge and intelligence [3].

There is also now a growing recognition of the need to understand the context within which information system would be embedded. Practitioners and researchers alike are taking a second look at how information systems are developed and implemented in organizations. System development and computing is not wholly an issue about technology but more about the organization where the technology will be rooted and about the people who will use it [9].

These developments highlight the need to align information system with organizational goals and business processes. It brings to the fore the important objective of information system, that of meeting the requirements of users and clients.

### Information System in Land Use Management and Governance

A land use information system is essential in handling and integrating databases. This role is particularly important as various applications, such as economics, demography, agriculture, and the like, are being integrated in land use planning and monitoring. The expected outputs are also becoming diverse as land use information is widely being used in many activities by different sectors. Integrating information also enables local government to provide varied products and services to clients.

The use of GIS in land use information system is becoming popular with its ability to link attribute and spatial data, integrate several map layers, do spatial analysis and modeling, and automates map processing. The system becomes a powerful tool for planners to do spatial analysis and to produce policy-relevant information.

As discussed above, land use in local government has evolved from mere physical planning to management and governance. A land use information system can be developed to manage land use changes and to promote participative decision making. It can be used to decide, enforce, and monitor land use plans and policies. With publicly available and accessible information, the system can be a means to promote participation, transparency, and accountability.

## 3. THE CASE OF NAGA CITY

### The Urban Challenge

Naga City is located in the province of Camarines Sur, Philippines, which is one of the 6 provinces comprising the administrative region of Bicol. It is 377 kilometers south of Metro Manila, the capital city. Naga City is landlocked and shares boundaries with several municipalities (see Figure 1).

Naga City has a total land area of 8,448 hectares. 67.55% of which are agricultural lands, 14.30% residential, 7.23% forest parks and reserves, 5.97% grassland, 1.92% commercial, and 1.78% institutional [5]. Naga City has 27 *barangays*—the smallest administrative unit in the Philippines. These *barangays* have built-up areas and have an average population density of 1,503 people per square kilometers [5]. Based on the 2000 census, the population of Naga City stands at 137,810. The number of households totals 26,317.

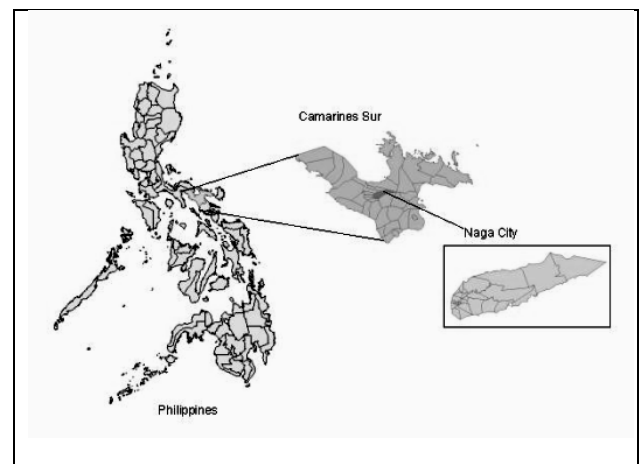


Figure 1. Philippine Map with an Inset of Naga City

Land use continues to be a critical concern for Naga City. The unprecedented growth it experienced in the past years has been exerting pressure on existing services and facilities. The projected rise in population and the growing importance of Naga City in the region as service and commercial hub impact on land use processes and priorities. Conversion of prime agricultural lands is one of the development constraints

identified in the CLUP, including deforestation, flooding, pollution, and incompatible uses of land.

### **Harnessing Urban Governance**

The Naga City local government has been widely recognized for its innovative leadership and governance. It has earned many awards both here and abroad [8]. It has successfully forged partnerships with the private sector and non-government organizations in formulating policies and implementing development projects.

Its latest initiative comes under the name i-Governance. It aims to bring information to the people and to open communication channel for average citizens to get involved in local government affairs. It is made operational through the Naga City website and the Naga City Citizens Charter. Through this initiative, citizens can easily access public documents and detailed information about services, and can directly communicate with local government through emails and text messaging or SMS.

### **Issues in Land Use Planning and Monitoring**

The CLUP of Naga City was approved in 2000 by the Housing and Land Use Regulatory Board (HLURB). A zoning ordinance was then passed by the *Sangguniang Panlungsod*, the local legislative body. The City Planning and Development Office (CPDO) of Naga City Hall ensures public compliance with the CLUP and the zoning ordinance through the issuance of zoning clearances and certificates of site zoning classifications. It monitors land use changes by keeping and updating records on actual land use, conducting on-site inspection, and issuing permits, clearances, and certificates.

The local government is faced with various issues and challenges in managing land use. The following were identified based on interviews, observations, and documents collected during a field study in Naga City in September 2003.

**Much data but less analysis.** The CLUP is a rich source of data assembled from various sources about sector concerns. Analysis can be strengthened by using the data for evaluation, scenario building, forecasting, and other forms of analysis.

The seeming lack of analysis in planning may be traced to the practice of carving out land use areas without first closely examining processes and land requirements for various sectors. Analysis is also hampered by the absence of a system to handle and integrate existing databases. The Electronic Data Processing Unit (EDP) of Naga City Hall provided technical support in the formulation of the CLUP by preparing land use maps. GIS software was used to automate the cartographic process. This, however, has not been maximized. No systematic assessment, for instance, was done to identify suitable areas for conversion or to determine whether a proposed facility is appropriate or not given a set of criteria.

**Planning as one-shot activity.** The CLUP does not end with the approval of the HLURB or the passage of a zoning ordinance. Viewed from the perspective of urban management, implementation and monitoring should follow through after planning. A phase-out plan to address non-conforming land use arising from the adoption of a new CLUP is one example.

Land use conversion is another issue that needs further study and planning. Monitoring land use changes should be done systematically and regularly. In Naga City Hall, different offices implement their individual programs. The CPDO collates annual office programs and checks accomplishment of targets. The CPDO could use the review process to link the CLUP with office programs and with the fiscal and investment planning cycle.

**Issuance of clearances and certificates as mere document processing.** Decision-making happens at different levels, sites, and units of the organization. Decisions are not only the exclusive domain of policy, but also occur at the management and operation levels. Issuing zoning clearances and certificates for site zoning classification are frontline services of the CPDO. This service involves more than just processing of documents. It entails decision-making that requires information, judgment, and a consideration of strategic factors and long-term effects. This should be guided by substantive concerns, such as sustainable development and community benefit. As such, the task of issuing clearances and certificates goes beyond checking for compliance of proposed projects with planned zoning.

### **Issues in Databases and GIS**

Efforts have been initiated to digitize analog data and build databases. A GIS software has been acquired and map layers have been generated through technical assistance projects. The EDP is tasked with computerizing procedures, and operating and maintaining the local GIS and the Naga City website. Problems, however, still exist.

**Unstructured analog data.** Data collected during the formulation of the CLUP were not structured, stored, and catalogued for manipulation, re-use, and maintenance. The same is true with the daily transaction for clearances and certificates, where data generated remain in filled-out application forms and where certificates, clearances, and summary reports are encoded each time they are produced.

**Islands of automation.** Existing databases inside Naga City Hall are not integrated. Integrating databases would facilitate data sharing among various offices inside City Hall. Only two offices maintaining tax declaration and tax payment records share the same database with specified fields for view, encoding, and updating. This should be considered in the computerization program of EDP given the frequency of internal transactions within the various offices and the volume of data flows from one office to the other.

The absence of a key identifier to join and relate datasets of offices inside Naga City Hall hampers data integration. Another concern is the heterogeneous data models, schemas, and software platforms being used. The offices inside Naga City Hall have their own way of keeping records and maintaining datasets. They have computerized at different points in time with the objective to automate specific tasks.

**Difficulty in sustaining GIS initiatives.** Naga City was able to set up its GIS and procure GIS software, equipment, and satellite image through donor assistance. The first technical assistance came in 1993 and 1994, which trained a number of local governments on land use mapping and rapid land use

assessment [7]. The second assistance followed in 1999, which pilot-tested various GIS applications, such as the following: fire risk assessment; building information; real property tax; monitoring socialized housing amortization; monitoring business permits; and nutrition for pre-school children. The initiatives, however, were not sustained. The offices concerned were not able to continue the use of GIS in their operations. This can be attributed to the “lack of senior champion capable of moving the applications forward” [7]. Another reason is the problem of retaining personnel trained in GIS.

**Unused location-based datasets collected in daily operations.** Address is one dataset that is being collected in almost every transaction of local government. Address is location-based, which can be applied to code and identify areas, properties, facilities, and similar objects in space. This can be incorporated in a GIS. Address dataset is oftentimes incomplete since data properties are not structured and well-defined. This is commonly set as long data string, which yields records with either the name of street only or the name of *barangay*. There is a need to look into address datasets and standardize a system to make it useful to local government.

#### 4. A DESIGN SOLUTION

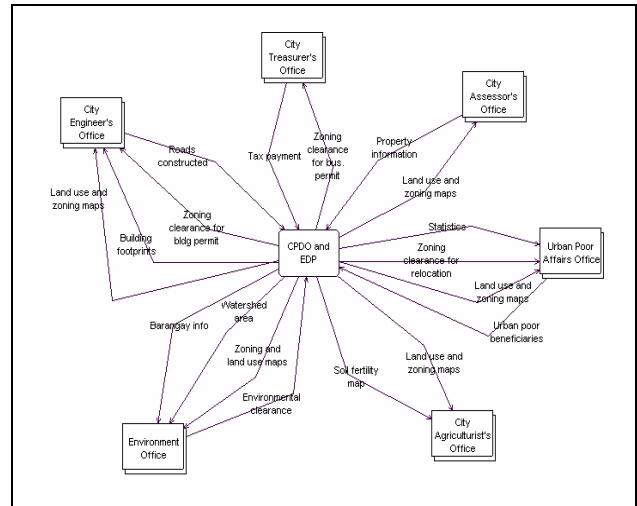
This section proposes a design solution for a land use information system. User requirements are defined and modeled, and a System Architecture is formulated based on developments in land use and information system, and the issues facing Naga City local government.

##### The Users

The primary actors for the proposed system are the CPDO and the EDP. The information system is intended to support land use management, which is the mandate of CPDO. As the computer and network office inside Naga City Hall, the EDP has the technical know-how on database management system and GIS. These are the core offices that should be responsible for developing and maintaining the system.

Other offices inside Naga City Hall transact with the CPDO and the EDP on a frequent basis as illustrated in the context diagram in Figure 2. The development of a land use information system would facilitate the transaction between and among these offices. The operational databases maintained by these offices are important components in the proposed system.

Supporting actors include customers or clients. They are the people transacting business with Naga City Hall, those taking part in public consultations, and any private citizens and groups involved in land use issues. They are both service recipients and users of the system. Other supporting actors are government bodies, both local and national, which are currently data providers but can be potential users of the system once local data become accessible and shareable.



**Figure 2. Data Flows Between CPDO/EDP and Other Offices in Naga City Hall**

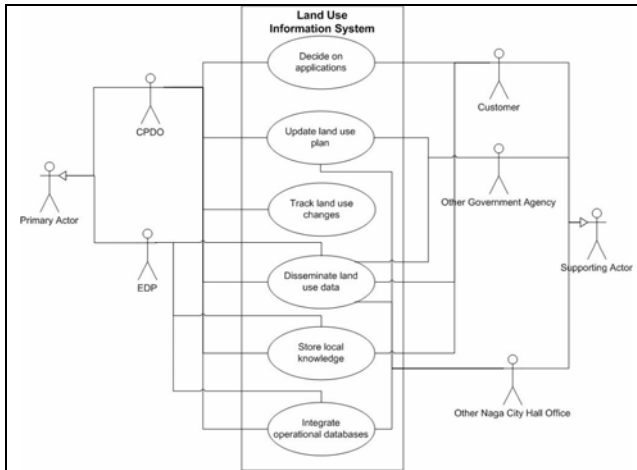
##### The Requirements

Based on CPDO records and client survey, most applicants go to the CPDO to apply for zoning clearances. A total of 831 zoning clearances for building permits were issued in 2002, averaging 69 applications per month. About 4,401 zoning clearances for business permits were issued in the same year, averaging 367 permits per month. With regard to certificates for site zoning classifications, record shows that the CPDO approved 550 applications from 1990 to 2000, at an average of 50 per year or 4 a month. These applications involve more than 1 parcel or group of parcels for real property developments.

Data provision comes in second in terms of client demand. Majority of the respondents prefer that land use data and general information about Naga City are available in digital format and are accessible in the website.

The Use Case Diagram of Unified Modeling Language (UML) is used to identify the users and to translate user requirements into system functions. The diagram defines the system boundary and identifies the actors interacting with the system. It also shows the relationships of the various system functions by defining their dependencies.

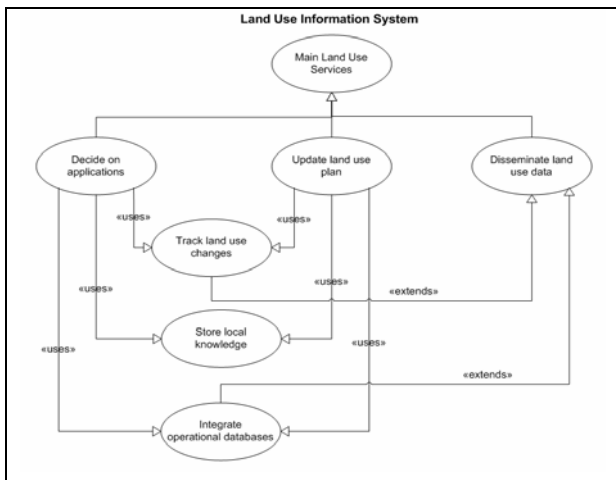
The system functions or Use Cases are depicted in terms of goals of the primary actors, that is, the CPDO and the EDP. Based on emerging trends in land use and information system, and the requirements of users, the following are the Use Cases of the proposed land use information system: (1) disseminate land use data; (2) decide on applications; (3) update land use plan; (4) track land use changes; (5) integrate operational databases; and (6) store local knowledge (i.e., views, comments, reports from citizens). The Use Case Diagram is shown below.



**Figure 3. Use Case Diagram of Land Use Information System**

In Figure 3, the CPDO is associated with all six Use Cases. It is responsible for deciding on applications for zoning clearances and certificates for site zoning classifications, for updating land use plans, and for disseminating data on land use. The CPDO performs these responsibilities by tracking land use changes, capturing local knowledge, and accessing operational databases. The EDP is tasked to develop and maintain the databases and provide technical support. The Customer initiates the application process, secures data, and participates in local public affairs. Offices inside City Hall participate in updating land use plans, providing and disseminating relevant data. Other government offices provide data as inputs to land use planning. They also access and use data from local government.

Figure 4 shows the dependencies of the 6 Use Cases. Three Use Cases are generalized as main land use services. The Use Cases Update land use plans and Decide on applications “use” or depend on the other three Use Cases. For the two Use Cases Track land use changes, Store local knowledge, and Integrate operational databases. The Use Case Disseminate land use data are extended or augmented by the Use Cases Track land use changes and Integrate operational databases. The former may use the latter Use Cases, implying a non-obligatory dependency.

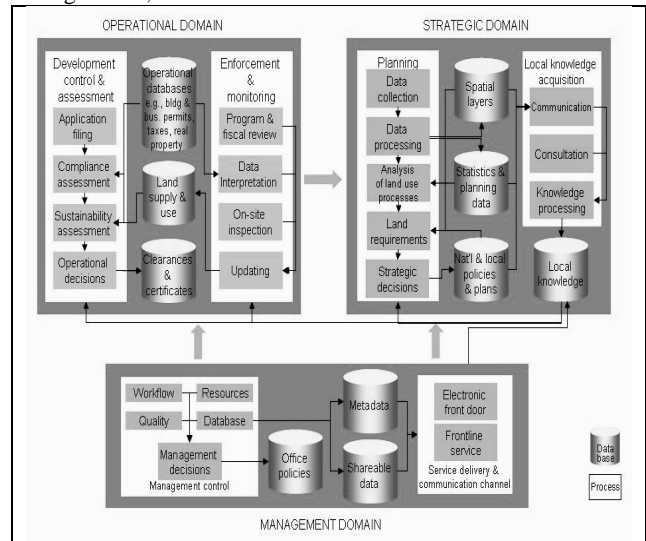


**Figure 4. Dependencies of Use Cases**

## The System Architecture

The System Architecture shows the various components of the system and the roles and relationships of these components. The components are defined in terms of data and processes. They are grouped into three organizational domains or areas of concern, namely: operational domain, strategic domain, and management domain as shown in Figure 5.

**Development control and assessment.** The filing of application (e.g., acceptance of application, checking for completeness of documents) and compliance assessment (e.g., establishing ownership, ensuring updated tax payments, ensuring area falls within planned zone) are existing but done manually. A new addition to the design is the assessment of sustainability. This integrates strategic concerns, such as community benefit, amenity, and sustainable development. The process needs to integrate the databases arising from daily transactions inside Naga City Hall. Data on land supply and use shall be gathered to input to sustainability assessment and also to planning in the strategic domain. Zoning clearances and certificates for site zoning classifications, which are kept in analog format, shall be stored in a database.



**Figure 5. Information System Architecture for Land Use Management**

**Enforcement and monitoring.** The sub-processes are currently practiced in one form or the other. However, they are not applied to land use enforcement and monitoring. Program and fiscal review, for instance, falls within the mandate of the CPDO but are not clearly linked to the CLUP. The formation of a monitoring team composed of the CPDO and the City Engineer’s Office to conduct on-site inspection remains a proposal in the CLUP. Interpretation of land-related data to monitor developments is done on an ad-hoc basis. The need to update land use on a regular basis shall be part of the monitoring process.

**Planning.** Data generated from the operational domain shall input to the strategic domain, particularly in the planning process. Effective planning would largely depend on how available data are current and reliable to represent reality on the ground. The planning process is fairly established with the

guidelines set by the HLURB. The proposed process, starts with data collection and processing, e.g., data extraction, conversion. It establishes a demand-driven planning. That is, it focuses on the analysis of land use process as an important step in determining land requirements. Map layers developed through GIS are used more for spatial analysis, and data generated from planning are structured and stored in a database system.

**Local knowledge acquisition.** This is a new component in the sense that the concern to systematically collect and store inputs from the community is made part of the system. The concept is not new, however, insofar as community participation in local decision-making in Naga City has been institutionalized. An important part of the process is the development of a communication plan and strategies to induce public participation in land use planning and monitoring. Public consultations can be used as means to gather local knowledge. There is a need to define what inputs are important and how to collect them.

**Management control.** This is the process that coordinates and controls activities in the operational and strategic domains. It ensures intra and inter-organizational communication, resource allocation, quality standards, and data sharing. From this process, management decisions are formulated, which in turn are stored as office policies affecting the three domains. An important component of the control process is database management, which coordinates the production of metadata (i.e., description of data) and shareable data from the other domains for public access. This also provides for the interface needed for data conversion, handling, and exchange.

**Service delivery and communication channel.** Services and information shall be delivered in two ways: through the electronic front door which is currently available through the Naga City website and through frontline services which are the face-to-face transactions with the public. The electronic front door and frontline services are open lines of communication to the public, which can be exploited for land use planning and monitoring. Transactions, such as application processing, however, are still limited in the internet by institutional and banking regulations. This electronic front door shall be tapped to generate inputs from local residents and to make publicly available mapped and thematic information on land use.

Statistically, 12 out of the 22 sub-processes identified in the System Architecture are proposed for adoption while 10 already exist. For the databases, 7 are new and 3 are in place. Overall, about 60% of the system is new and has to be developed.

## 5. CONCLUSION

This concluding section defines how the information system can improve land use processes in Naga City Hall. It presents the implications of the proposed system for land use management and local governance.

**The development of land use information system can serve as platform to integrate data and facilitate data exchange in Naga City Hall.** Developing an information system for land use presents an opportunity for local government to store, maintain, integrate, and share data. Land use is a common concern of various offices inside Naga City Hall. Transactions on building and business permits, tax assessments and payments, are all tied to zoning regulations and land use policies.

**A land use information system enables proactive decision-making.** Processing of applications should be seen as a decision-making function that evaluates applications in terms of strategic factors. An information system enables such function to be realized where developments in an area can be monitored, possible effects can be anticipated, and impacts of applications around surrounding areas can be evaluated. A land policies database is included in the proposed system to guide assessment and planning. With an information system, available data can be retrieved easily, aggregated, and interpreted for decision-making. Analysis of spatial and non-spatial data can be done to relate an application to its environment and visualize it at different scales and various levels of details.

**A land use information system can be a means to induce community involvement in land use issues.** Public consultation is a basic tenet of local governance. The present local administration has pursued this through public-private partnerships, the involvement of civil society organizations, and lately with i-Governance. Public consultation that involves community action can be a venue for planning and deciding land use issues. A land use information system can be a tool for community involvement through which land use information is disseminated and inputs from the public are gathered. Results of public consultation can be processed and recorded in the system.

**A land use information system can facilitate and enhance analysis for land use planning.** Naga City Hall is rich in both spatial and non-spatial data acquired during the formulation of the CLUP and generated daily from operations and transactions with the public. With the support of an information system, these data can be related and joined thus facilitating and enhancing analysis. This then can be used as input to planning. With an information system, planning can be done even outside the planning cycle that happens every 5 to 10 years, tackling land-related issues from traffic management, infrastructure, to eco-system development and private sector investment.

**A land use information system can be a tool for improving public service.** The information system is intended to support changes proposed in the land use processes of Naga City Hall. In the System Architecture, these changes range from the introduction of integrated databases, sustainability assessment, data interpretation, knowledge processing, to land supply and use, metadata and shareable data. Improving operations inside Naga City and using the information system for disseminating information and inducing community involvement can result in benefits for the public.

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## 7. REFERENCES

- [1] Bacon, James C. and Brian Fitzgerald, "Systemic Framework for the Field of Information Systems," **The DATA BASE for Advances in Information Systems**, vol. 32, no. 2, Spring 2001, pp. 46-67.
- [2] Dale, Peter F. and John D. McLaughlin, **Land Administration**, Oxford: Oxford University Press, 1999.
- [3] Klosterman, Richard E., "Planning Support Systems: A New Perspective on Computer-aided Planning," in **Planning Support Systems: Integrating Geographic Information Systems, Models, and Visualization Tools**, pp. 1-23, edited by Richard K. Brail and Richard E. Klosterman, California, Redlands: ESRI Press, 2001.
- [4] Masser, Ian, "Urban Planning Research Futures," Valedictory address delivered at the International Institute for Geo-Information Science and Earth Observation (ITC) at Enschede, the Netherlands, on 14 January 2003.
- [5] Naga City, Naga City Comprehensive Land Use Plan 2000, Naga City Hall, Philippines, 2000.
- [6] NAMRIA (National Mapping and Resource Information Authority), Philippines' National Spatial Data Infrastructure Framework Plan, January 2004.
- [7] PADCO, Inc., *Rapid Land Use Assessment: Experiences in the Cities of Cebu, Davao, Lipa, and Naga, The Philippines*, Volume 1, Main Report. Manila: USAID, 1994.
- [8] *Philippine Free Press*, "Naga City's Gallery of Awards from 1992-2003," **Philippines Free Press**, 20 September 2003, pp. 16-17.
- [9] Reeve, Derek and James Petch, **GIS Organizations and People: A Socio-Technical Approach**, London: Taylor and Francis, Ltd., 1999
- [10] United Nations (UN), **Municipal Land Management in Asia**, New York: UN and CityNet, 1995