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PLENARY - VOLUME 2

Data Integration for Urban Design: A Case Study

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Summary:
The paper presents a case study aimed to define a methodology for urban analysis and design applications based on different sources data integration.
The study is actually under development by a degree thesis and with the support of ISEI (Institute for Software Engineering) at CEC-JRC (Commission of European Communities-Joint Research Centre) of ISPRA.
The study is focused on the city of Firenze (Italy) and surroundings (the metropolitan area) keeping in analysis the problem of urban quality design according with the CEC official documents.
The aim of the study is to purpose an IT (Information Technology) based procedure for urban analysis and design particularly aimed to detect and evaluate natural elements such as trees and green surfaces in the town. Relationships with other out-door spaces, built o not, and other variables are also studied.
A simulation of the actual consistency of the green system compared with other non-visible urban systems and elements should be done and these should be compared with new solutions using what-if scenarios. Traditional 2D data report as well as 3D animated simulation will be provided by a pathfinder demonstration.

Subject
The presentation refers to a degree thesis [1] developed at LIS (Laboratorio Sistemi Informativi) [2] belonging to DPMPE at the Facoltà di Architettura of Università degli Studi di Firenze. The thesis is also supported by ISEI (Institute for Systems Engineering and Informatics) [3] at JRC (Joint Research Centre) in Ispra as a part of CEC-DGXII (Commission of European Communities).
The aim of the study is to define an innovative methodology and pathfinder demonstration of how to overcome specific scientific and technical problems in the urban environment analysis and design using IT methodologies. Particularly the project involves the priority use of EO (Earth Observation) data with the collaboration of both EO scientists and application specialists in early phases of data bases implementation.
Research tasks has been drawn from the following areas:
i-development of new IT (Information technology) procedures based on existing techniques and tools to obtain useful information from both EO data (provided by remote sensing images) and traditional (alphanumerical) data.
ii-definition of an appropriate data model and structures for a GIS (Geographical Information Systems) application looking to easy multi-source data integration.
iii-multimedia data presentation and report to facilitate the use of such kind of systems by non expert users like as urban designers and municipalities officers.

Context
One of the main problems in urban analysis and design is actually, with particular regard to Europe, to better understand the behaviour of the complex city system under the pressure of technological trends as well as life style development. Some analysis of the problem have been done in the literature and also some important official document have been published by the CEC (1990; 1994) on the topic. The complexity of the contemporary urban environment rises from a lot of interrelated socio-economics trends such as the urban population improving, the urban mobility pressure increasing (private and public transportation), high noise and air pollution, lost of residences in the city's historical centres, request of space for outdoor activities, request of offices buildings and telecommunication infrastructures, laid aside industrial areas, exigency of preservation of the historical buildings and urban environments, exigencies of new types of work organisation (i.e.tele-working), and so on. The CEC (1990) has been indicated the necessity to define priority actions for urban environment in relation to three important elements: urban environment pollution, built environment, natural elements in the urban environment. Some of this areas are have been yet exploited in study and researches, and also in pilot projects in many European towns. More recently the CEC (1994) has also suggested three strategic objectives in rising areas, where designers and administrators could apply the problem solving activity, as follows:
-AGORA: to develop new global urbanistic concepts aimed at the promotion of human centered city plans which, by applying technology options, will enable social cohesion and co-operation
-GLOCAL: to maintain the local diversity and valorise the local resources
-SUSTAINABLE: to contribute to develop simulation models and assess technology options to realise high quality urban environment.

[1] Student: Christiane Boehner; Tutors prof.P.A.Cetica and DR M.A. Esposito
[2] Scientific Responsible: prof.P.A.Cetica; Technical Responsible: DR M.A. Esposito
[3] With the collaboration of ing.S. Contini and Dr E.Nicoloyanni.

Assuming that to develop new global concept is not the problem here, the most of research efforts and the background idea of this study has been to contribute to develop a simulation model, and also assess the technological options to make this, with the aim to control and improve the urban quality. We can say that the more general objective of the study is to define a methodological tool for a sustainable town design.

The Geographic Urban Model
Because of Urban and industrial areas represent man's most evident modification of earth's surface this problem has been studied and modelled by geographer also using EO data support. The V-I-S model (Ridd et alii, 1992) for example serves as a basis for urban/industrial change detection and monitoring. The model points out three most fundamental compositional elements of the urban environment: vegetation, impervious surfaces, and exposed soil. These elements are used as well in contrast with surrounding landscape as in terms of ecological significance (see Fig.1). The V-I-S model has been based on the use of EO data through the identification of each single pixel as a part of these three groups of surface materials (ecounits). Therefore to distinguish and map these elements means to establish a basis for understanding urban ecosystem pattern and process. In this way the analysis of urban environment could be based not only on the land use but also enriched by ecologically significant properties of urban composition. Once this composition has been defined many applications are possible. On this base geographers could operate multi-date monitoring of the urban environment changes as well architects and planners could apply predictive modelling of their urban projects proposal through the use of GIS thematic mapping. Traditional applications of GIS technology is generally based on non-visible socio-economic variables implementation, using this model and inferring them (?) with visible-physical material's data we sure could improve our knowledge and capacity of representation of urban realty.

Main Targets
The main target of the thesis can be summariesed in the answer to the following questions:
a) Why nature in the city as a case study in urban environment#s design-management?
The answer refers to the Strategy Model.
b) How to define a procedure based on qualitative data integrated with quantitative data?
The answer refers to the use of Remote sensing techologies.
A system based on quality data can only consist in a simulation of the reality judged by the human brain versus the automated evaluation based on quantitative data. Morever a realistic simulation can base only on as actual data as possible. That means a continuous update of geografical data. guarantied today only by update on remote sensed and expecialy satellite data.
c) How to compare different urban systems as i.e. the system of vegetation in the city and the system of exposed soil?
The answer is base on the Geo-Model.

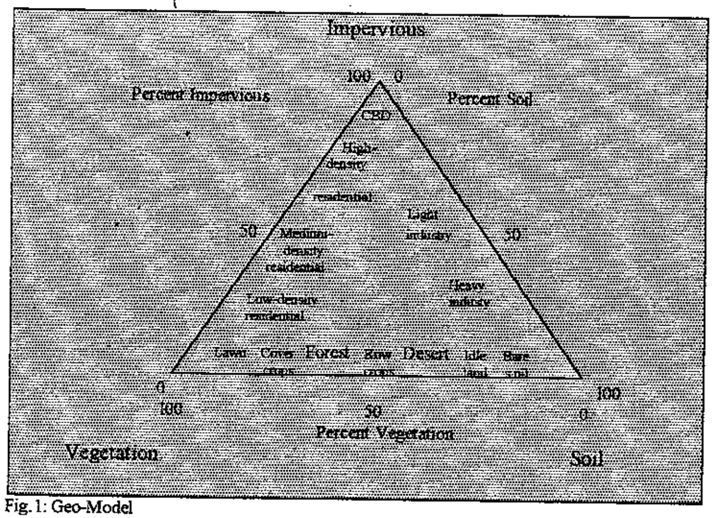

Fig. 1: Geo-Model
(Ridd M.K., Dudley-Murhy E."Global change and urban ecosystems: a role for remote sensing" in ASPRS-ACSM, "Technical Papers", 1992, Vol 4°)

d) How to combine administrative (non-visible) data and the other geo-physical (visible) attributes to support town management or architecture and planning applications in the case study?
The answer refers to the Focus on 2D-3D Data Report.

Objectives and diffusion of results
The analysis has been focused on the comparation of natural elements with others public spaces (built or not) in the urban environment using automatic elements identification from EO data loading. A case study has been chosen to apply the experiment: the town of Firenze (IT). The data base rising from the image processing of EO images captured by SPOT and LANDSAT satellites should be integrated with other Geo.-information (digital cartography) and also with alphanumeric non-visible data and images from available public data sources (fig.2-3-4).

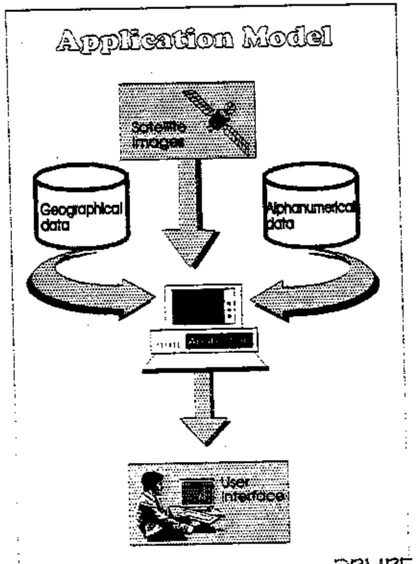

Fig.2: Application model

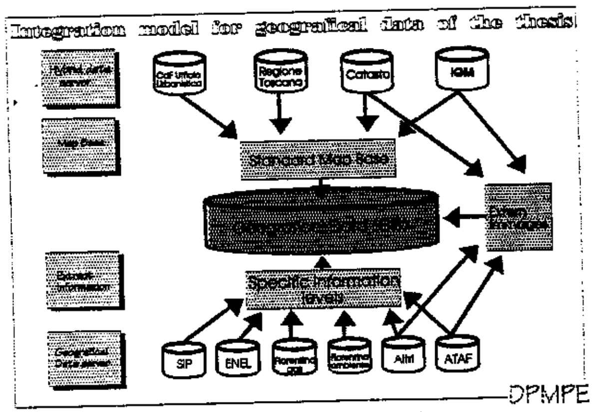

Fig. 3: Integration model of geographical data of the thesis

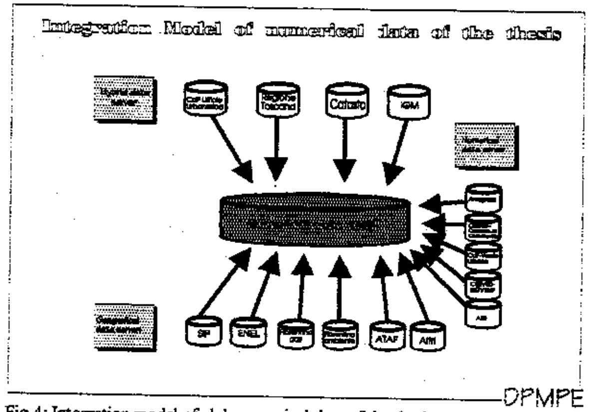

Fig.4: Integration model of alphanumerical data of the thesis

The census of the type and of the technical characteristics of locally available GI (Geographical Information) has been done. Different non-standard data sources been found and technical problem for the practical use of this data by a standard GIS support have been also detected and solved. Local available GI is often in digital form but different data formats are associated to different scale. In such way each application require the data re-structuration with costs improvement and quality (precision and reliability of data) lack. Although the systems technology is going to support much more data formats on the other hand the creation of public data sets follows in each case its own criteria. The absence of shared European and, in Italy even national, standards, for the small scale digital data plays a large role in the matter. One of the study sub-objective has been to keep known the real operative situation and to suggest technical solutions for the data integration problem applied to urban analysis.
The creation of an appropriate user interface will be very important phase of the work and should be defined by the specific functionality offered by the integration environment chosen (fig.4).

Florence : List of available geographic information

Institution	Format	Environment	Output scale 1/25000	1/10000	1/5000	1/2000	1/1000	1/500
IGM	Digest e derivati	UNIX, VMS	X					
Catasto	DXF	UNIX				X	X	
Regione Toscana	R.T. translatable to .DXF	UNIX			X	X		
Comune di Firenze - Ufficio Urbanistica	SIRSG (Geosystems) and derivate	VMS			X	X		
ENEL	Vari in dettaglio	UNIX, ARC/INFO, ORACLE	X		X	X	X	X
SIP	Standard SIP translatable to .DXF	VMS				X	X	X
FIORENTINA GAS	SIRSG	VMS				X		X
ATAF	TIFF	MACINTOSH				X		

DPMPE

Fig. 5: List of geographical data available on Florence

The definition of an appropriate data model and structures for a GIS application looking to manage the sample analysis by quarries should be provided as well as traditional thematic maps (2D report). An innovative tentative report will be also provided by the use of multimedia tools: a three dimensional simulation, directly built on the automatic DTM (Digital Terrain Model) joint to animation tools will allows the

visual control of the urban elements attributes (3D report). Although the traditional colour print output based on 2D representation is probably the more useful for the administrative procedures, the complexity of design process asks more sophisticated tools of control such as 3D representation and animation. This fact is connected with the holistic characteristic of the design control versus the quantitative nature of the administrative control.
The results diffusion has been planned by the production of a VHS standard movie for didactic use and by INTERNET/WWW shared files for research use.

Phases of work and scheduling

The development of the study and attached demo should be divided in 6 phases (see fig.5), that have taken token or will take place in part at DPMPE-LIS at Università di Florence in part at JRC-ISEI in Ispra.

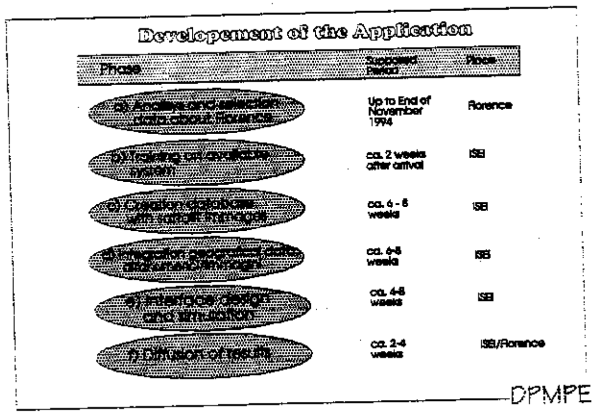

Fig. 6: Development of the thesis application

The 1st phase of analysis and selection of geographical and alphanumeric data have been done in Firenze also with the collaboration of the Municipality 's office of Urbanistica of the Comune di Firenze and of some local Organisation (such as Catasto, Istituto Geografico Militare, etc) and Companies (Fiorentina-gas, Enel, Sip etc.). The other phases (actually is in progress the phase C) are going to be developed at JRC-ISEI with the support of EO data process specialist. The phase B is dedicated to system training and the deadline is fixed on the day 28th of February '95. The phase C, with the creation of the EO data base, will be probably completed on the end of March 95 and the end of phase D, dedicated to data integration, is foreseen on the end of May 95 .The month of June 95 will be dedicated to the interface design and simulation tests. The whole work scheduled due date is on July 95, with the result diffusion and the discussion of the Degree thesis at the Università di Firenze.

Conclusion

We could agree with Ridd (1992) conclusion to need models of urban morphology and change appropriately to link with other ecosystems. This methodology shows that the analysis is also applicable to urban planning and design and even to urban management operated by Public/Private Bodies charged for sectorial services (such parks and health care, schooling, transportation) or facilities (gas, electricity, telecommunication networks). Because needed are global models, Geographical Information, especially integrated with visible data from remote sensing, should constitute the common reference to the territory to understand and manage the whole elements of the complex urban realty.

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