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Environmental Compatibility and Computer Aided Decision Making Related to the Third University in Rome: An Integrated Application of Several Methods: A.H.P., S.A.M., C.A.V.I.A.

Synopsis

The EC Human Capital and Mobility Project, has allowed collaboration between Universita' di Roma "La Sapienza", and **University of Strathclyde (Glasgow),** on a research programme developed by the author, co-ordinated by Prof. **E. Mortola** and **A. Giangrande** of Universita' "La Sapienza", and Prof. **T.W.Maver** with the collaboration of Mr **M.Grant**, of University of Strathclyde.

The research consists on an integrated application of assessment methods that will allow designers, planners, and public administrators to operate on defined rules, to evaluate "a priori" the designing and planning parameters.

The new integrated operating method, could be used for the elaboration of developing urban plans, or even for public design competition assessment.

Presentation

The research aims to elaborate a set of preliminary studies concerning the third University in Rome, which should be useful for design and environmental compatibility analysis.

It could also be useful to give designers and local authority information regarding the relative importance of the planning parameters, and to determine schemes of aided decision making to:

-locate the project (e.g. Valco S.Paolo or old industrial area at Ostiense);

-identify alternative interventions (e.g. new buildings revaluing the old urban system, or "reuse" of existing obsolete structures)[1]

Goals

The research's goal was to elaborate a complex coordined methodology of Environmental Impact Analysis, structured in three stages, each one corresponding to a method previously developed independently or in collaboration by the research department D.P.A.U [2] of Universita' "La Sapienza" and ABACUS [3] of University of Strathclyde.

The steps to do it are the following:

- knowing the methods developed independently or in collaboration by both Universities;
- making a comparison between them;
- using them in a complementary and integrated way.

The methods

The process consists of the integrated application of three existing methods: A.H.P. (Analytic Hierarchy Process), S.A.M. (Sensitivity Analysis Method), and

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[1] regarding the EC prescription defined in the "Green Book on Urban Environment" by the EC Environmental Council, approved by European Parlament in september 1991, to outline the possible community ways of action.

[2] Dipartimento di Progettazione Architettonica e Urbana, Roma.

[3] Architecture and Building Aids Computer Unit Strathclyde, Glasgow.

C.A.V.I.A. (Computer Aided Visual Impact Analysis) (**fig.0**). These three methods had been applied and developed independently or in collaboration in previous research projects by D.P.A.U. and ABACUS.
The original contribution of the present project is in the incomplete use of each method. Each one is mutually complementary to the other. The outcomes of each one are to be read bearing in mind all three methods used.

-The Analytic Hierarchy Process.
This is a support method to aid multicriteria decision-making, developed by T.L. Saaty. There are several examples of this method applied to the assessment of very different classes problem.
It can be used to fix the cost/benefit ratio of a project, when it is impossible to evaluate in monetary terms the advantages and disadvantages following from its realization.
Generally, the method allows the user to evaluate the priority of "actions". These "actions" could be:

-programmes
-strategies
-plans
-projects
-criteria
-etc.

In the case of this study the method has been applied using Hypercard (Macintosh hypertext software), in the way developed by Professor A. Giangrande of the University "La Sapienza" of Rome.
Using it has been possible to define the global weights and relatives uncertainty intervals of elements of "Dominance Hierarchy", which is the basis of the method.
The process stages as follows:

(**I**) definition of "Dominance Hierarchy", on which are hierarchically fixed in a tree structure the goal, the criteria, and the actions, using intermediate levels of sub-criteria and primary and secondary actions **(fig.1),**
(see Annexe A of final report of HC&M fellowship);
(II) definition of local weights using paired comparison procedure. At this stage, the evaluations are done in observance of two scenarios corresponding to the hierarchies second level: (**fig.2a- 2b**)

-**political and economic scenario**; to which has been assigned a major weighting to economic criterion of "minimizing costs assuring the urban quality"(**$**);
-**scientific research scenario**; to which has been assigned a major weighting to scientific criterion of "maximizing the new University functionality" (**UNI**).

(**III**) definition of global weights or hierarchy terminal elements priority (fig.3a-3b).

The third point can be considered the end point of this research stage. From the global weights is possible to deduce useful prescriptions for designers, planners and public administrators: (e.g. in the competition for designing and building the third University in Rome, it would be possible to indicate on the announcement of the competition:

-the importance of designing parameters;
-the criteria considered by the jury',
-the criteria's weights, on which the jury will consider the project.

That would also pursue the exigency of objectivity and transparency of each competition activity.

It is really interesting to note the correspondence between the outcomes of the two political and scientific scenarios. As shown in fig 3a and 3b, they are substantially in the same hierarchy order, being not equal in value. It could mean that they are comparable to each other, and also confirm the method validity. In other words, comparing that

outcomes, it is possible to deduce the hierarchic order of importance of design parameters, regarding both the scenarios.

- **The Sensitivity Analysis Method.**

S.A.M is an assessment method composed of several stages, that uses existing methods as A.H.P. and M.C.D.A. (Multicriteria Decision Aid). It refers to the intrinsic quality of the site previously subdivided into geometric squares 200m per 200m called Territorial Units (TUs). Each TU is assessed on his sensitivity for several criteria.

The defined criteria are four:

- **Historical sensitivity;**
- **Architectural sensitivity;**
- **Frequentation sensitivity;**
- **Environmental-naturalistic sensitivity.**

To these is added a detractor criterion:

- **Urban landscape quality**.

For each criterion five sensitivity levels (**see annexe B of final report of HC&M fellowship)** are defined, and for each level a local weight using a paired comparison procedure is established.

In other words the A.H.P. has been applied again, using it in a limited way and on different conditions: once defined the "Dominance Hierarchy" (**fig.4**), is assigned the same weight (0.25) for each of the four elements of the second level of the Hierarchy (criteria), and then paired comparisons are used to assign the local weight to each sensitivity levels of the criteria.(**fig.5a-5b-5c-5d**).

In this circumstance the compute of the hierarchy terminal elements priority is missing since it would not be meaningful.

The following steps consist of the elaboration of the 4+1 sensitivity maps (**fig.6a-6b-6c-6d-6e**), assigning a level of sensitivity for each criterion to each TU.

It is at this stage of the process that the subjectivity of the judgement assigned by the expert or team of experts, emerges.

To avoid an excess of subjectivity, the author assigned the level of criterion using several maps and data, and tried to make the judgement the most impartial possible using definitions of levels of criteria that are very objective (e.g. definition of building typologies or presence of law limitations).

The method should now he improved by the following steps:

-Definition of global sensitivity map, proceeding on assembling criteria, using the M.C.D.A. method;

-location of visual basin relative to detractor (factories, highly degraded sites, etc.);

-location of "key observer points" (KOPs), and assessment of actual and potential landscape quality from these viewpoints.

But at this stage of the research these steps are missing because of the following reasons:

- the research goals did not need the definition of global sensitivity, because landscape sensitivity quality assessment are not requested; but it aims to know "a Priori" the sensitivity of a large urban area that would be partially involved by the examining case of study.

-the meaning of visual basins and of KOPs is strictly related to rural rather than urban contexts

It was therefore decided that the 4+1 sensitivity maps were meaningful enough to achieve the intended results of this stage of the research:

(**I**) giving objective elements to planners and urban management authority to work up an urban landscape plan;

(**II**) making easily knowable, understandable, and interpretable, the intrinsic qualities of the site.

(**III**) enabling local authorities or competition Junes to assess the new projects environmental compatibility.

-Computer Aided Visual Impact Analysis.

The third stage of research of the elaboration of a tridimensional model of the area, to be occupied by the third university, that is the Rome ex-industrial area of Ostiense (**fig. 7a-7b-7c**).

At this stage has been applied the C.A.V.I.A method developed by A.B.A.C.U.S. is applied.

The C.A.V.I.A method has been defined as: "A comprehensive and integrated suite if software, enabling designers and engineers to assess the visual impact of man-made objects in the urban and rural landscape" [4].

The C.A.V.I.A method comprises a large number of inter-related modules which enable the user to answer two important questions regarding the visual impact of proposed interventions in the urban and rural landscape:

- what will be the degree of visibility of the project in the landscape?
- what will it actually look like from any particular viewpoint ? [5]

To answer these questions was the aim of this stage of research.

The tridimensional model (**see annexe D of final report of HC&M fellowship)** is also useful because:

(**I**) - it reproduces the present condition of the area, with the building's volumes, the empty spaces, the roads, the river, etc.,

(**II**) - it allows the user to check the ratio between the building and the areas which sensitivity levels are highly different as shown in the sensitivity maps drawed up before.

(**III**) - it allows particular and detailed views of public unused buildings where the new University could be sited;

(**IV**) - it allows the user to simulate the presence of new buildings;

(**V**) - it allows the user to assess the visual impact of new projects.

(**VI**) - it allows the user to verify the functionality of mitigation procedures on the visual impact of new projects.

Furthermore the model could be the starting point of a coordined Urban Information System.

A Utopian view of the ideal Urban Information System would he an open system which would contain disparate yet standardised databases linked to what is essentially 3-D cartography. [6] (**see annexe C of final report of HC&M fellowship::**

hypertext on which are stored data and related to the buildings of the area, regarding the same grid used for S.A.M.).

The quality of the planning and decision making processes can be substantially improved where valid data is appropriately and efficiently handled. The use of such a Urban Information System allows data to be assembled and applied in new ways [7] The use of a graphically oriented informationsystem has the following advantages:

- the ability to use a readily understandable and recognisable medium with which to communicate proposed strategies and outcomes will make the task of disseminating policy open to all;
- - the use of a digitally accurate urban model will open up greater roles for simulation based tools [8].

(4) Petric J. (1991).
(5) Ibidem
(6) Grant M.P. (1993)
(7) Ibidem
(8) Ibidem

Conclusions

This research, being strictly tied to a specific case of study, needed a wide knowledge of the theoretic basis of Environmental Impact Assessment, developed from the beginning of seventies.

Twenty years after many advances have been made, both in scientific research and in legislative aspects. However there are a lot of experts, in this sector who regret the dearth of methods and of laws relating to it.

Usually the assessment process is limited to a post-project evaluation of proposed alternatives , and suggestion of mitigation procedure to minimize the impact of the proposed project.

The presented research aims to be a contribution to develop the E.I.A. sector on a defined science with its methodological rules, and to introduce the concept of assessment "a priory" of large scale projects, and even of urban and territorial plans.

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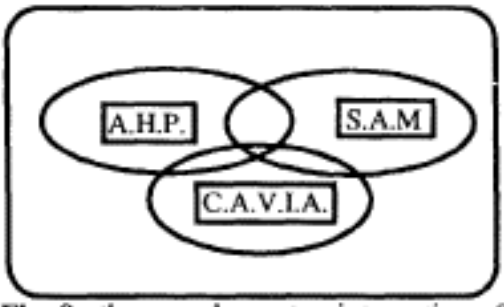


Fig. 0: the complementar integration of A.H.P.,S.A.M., and C.A.V.I.A.

CREARE UN TERZO POLO UNIVERSITARIO A ROMA NELLA ZONA OSTIENSE-VALCO S.PAOLO, CHE RISPONDA ALLE ATTUALI E FUTURE ESIGENZE UNIVERSITARIE E CHE SI INTEGRI CON IL CONTESTO URBANO E SOCIALE SECONDO IL MODELLO DI "PIATTAFORMA ATTREZZATA".

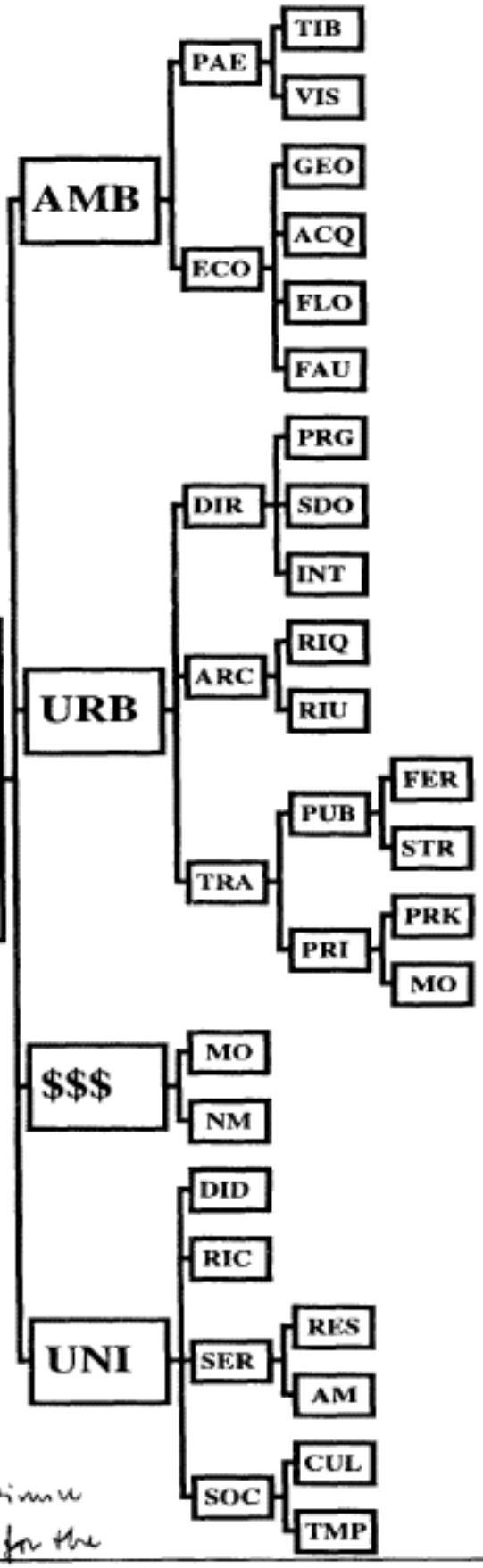
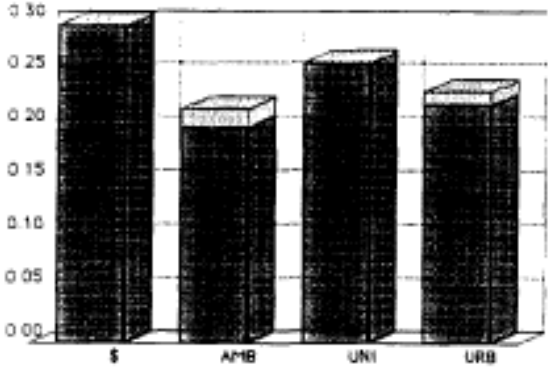


Fig. 1: A.H.P.: Hierarchy Dominance

L Goal = to optimize the Urban Design for the

Fig 2a: Analytic Hierarchy Process: political and economic scenario:
local weights of second level of Dominance Hierarchy (criteria).



	min	med	max
$ *	0.297	0.297	0.297
AMB	0.202	0.210	0.218
UNI *	0.263	0.263	0.263
URB *	0.224	0.229	0.236

*)Ipotesi di normalità respinta

	min	max
autov.	4.0004	4.0022
CR(%)	0.0	0.1

Fig 3a: Analytic Hierarchy Process: political and economic scenario:
global weights or terminal elements (goals) priority.

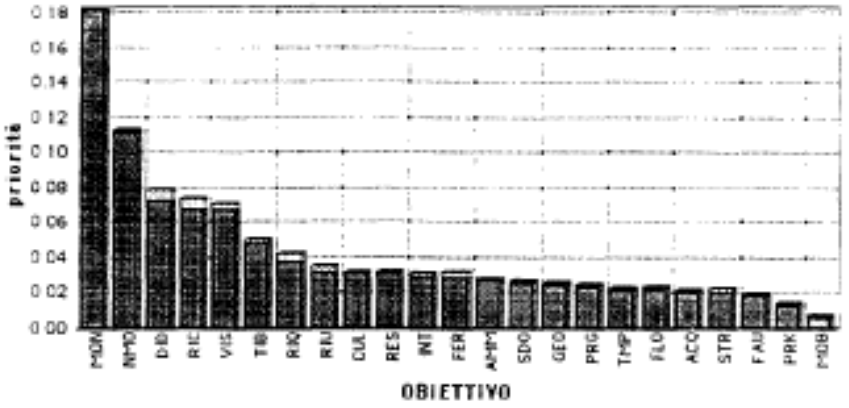
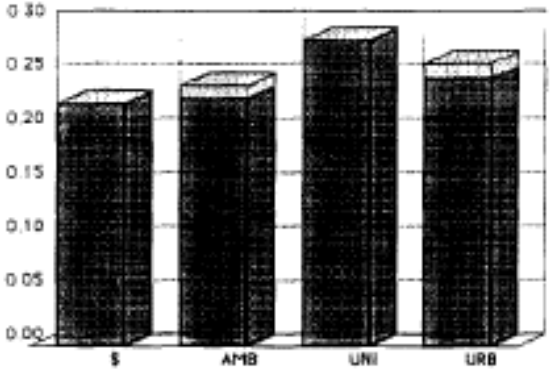


Fig 2b: Analytic Hierarchy Process: scientific research scenario:
local weights of second level of Dominance Hierarchy (criteria).

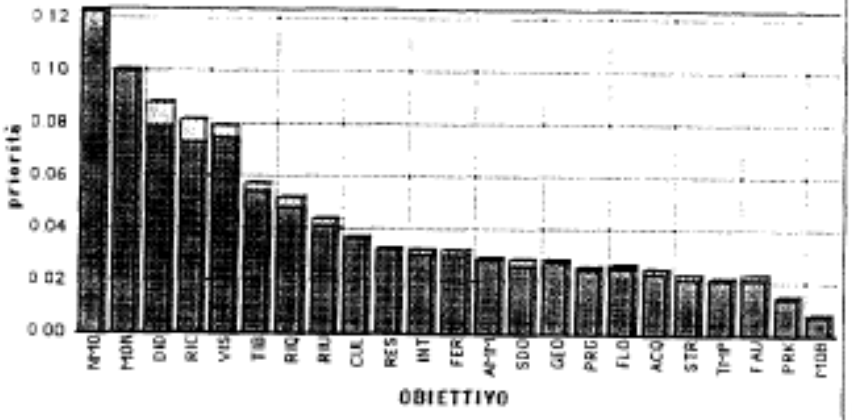


	min	med	max
$ *	0.225	0.225	0.225
AMB*	0.230	0.235	0.242
UNI *	0.284	0.284	0.284
URB *	0.249	0.256	0.262

*)Ipotesi di normalità respinta

	min	max
autov.	4.0026	4.0050
CR(%)	0.1	0.2

Fig 3b: Analytic Hierarchy Process: scientific research scenario:
global weights or terminal elements (goals) priority.



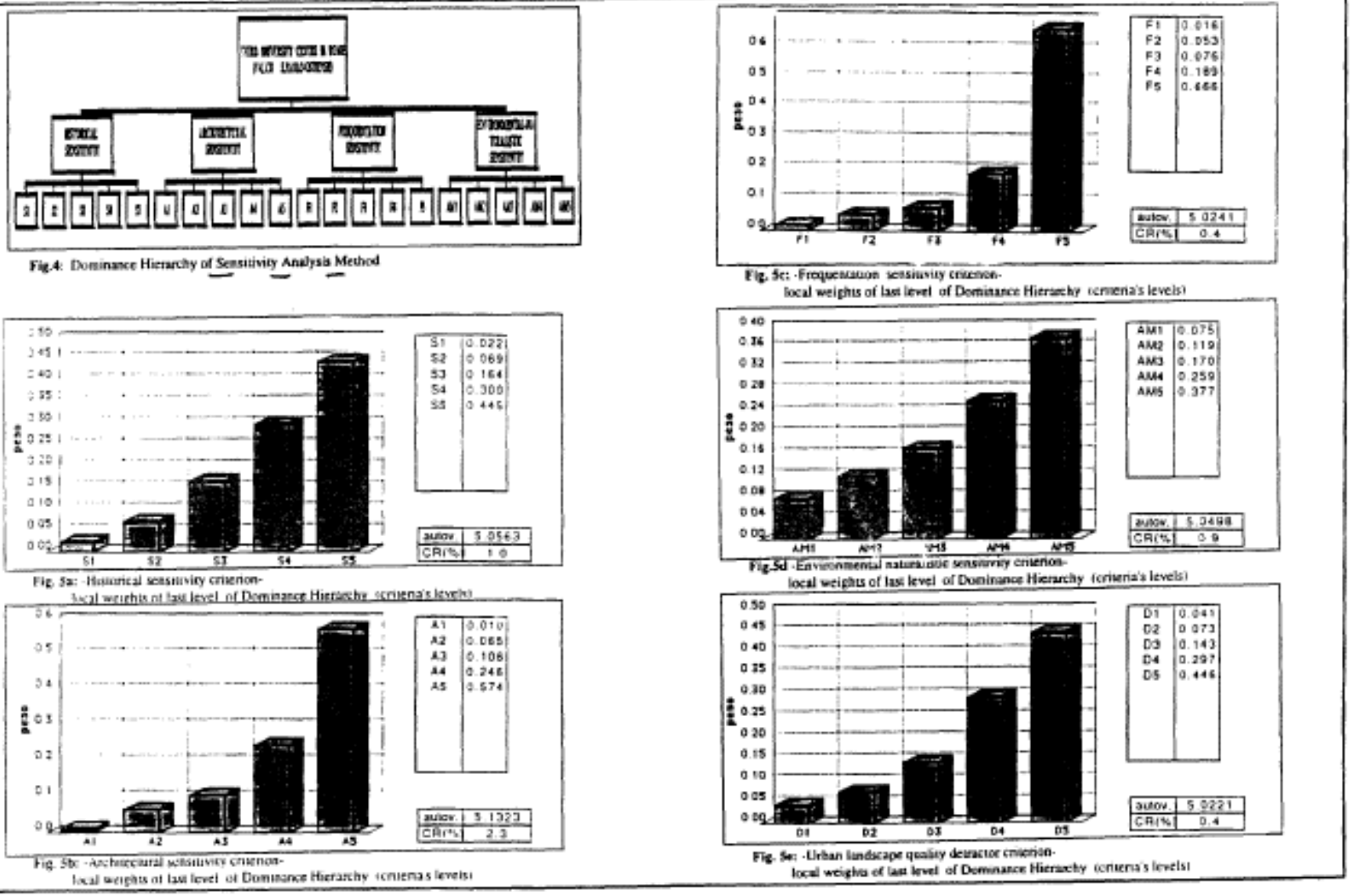


Fig.4: Dominance Hierarchy of Sensitivity Analysis Method

Fig. 5a: -Historical sensitivity criterion-
local weights of last level of Dominance Hierarchy (criteria's levels)

Fig. 5b: -Architectural sensitivity criterion-
local weights of last level of Dominance Hierarchy (criteria's levels)

Fig. 5c: -Frequentation sensitivity criterion-
local weights of last level of Dominance Hierarchy (criteria's levels)

Fig.5d: -Environmental naturalistic sensitivity criterion-
local weights of last level of Dominance Hierarchy (criteria's levels)

Fig. 5e: -Urban landscape quality detractor criterion-
local weights of last level of Dominance Hierarchy (criteria's levels)

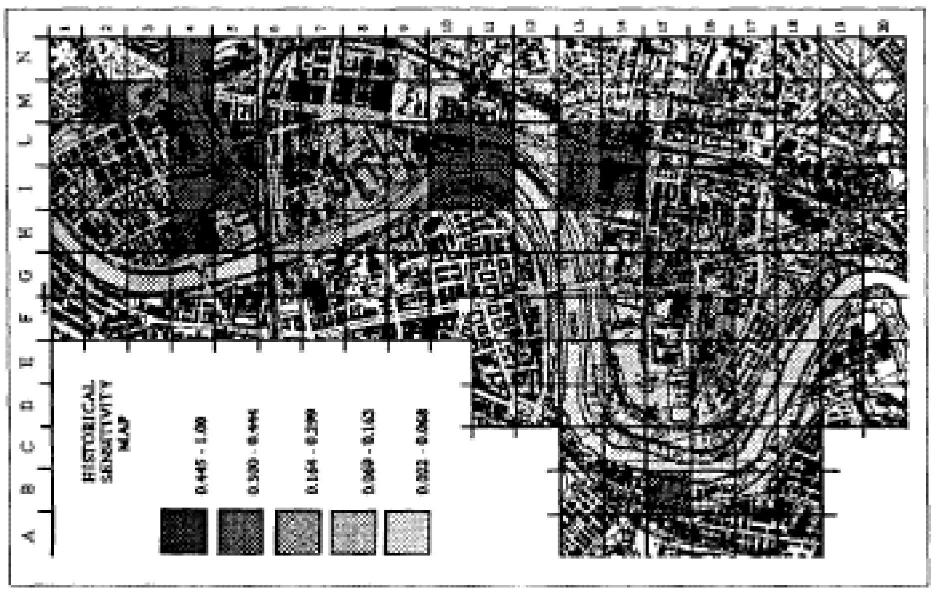


Fig. 6a: historical sensitivity map.

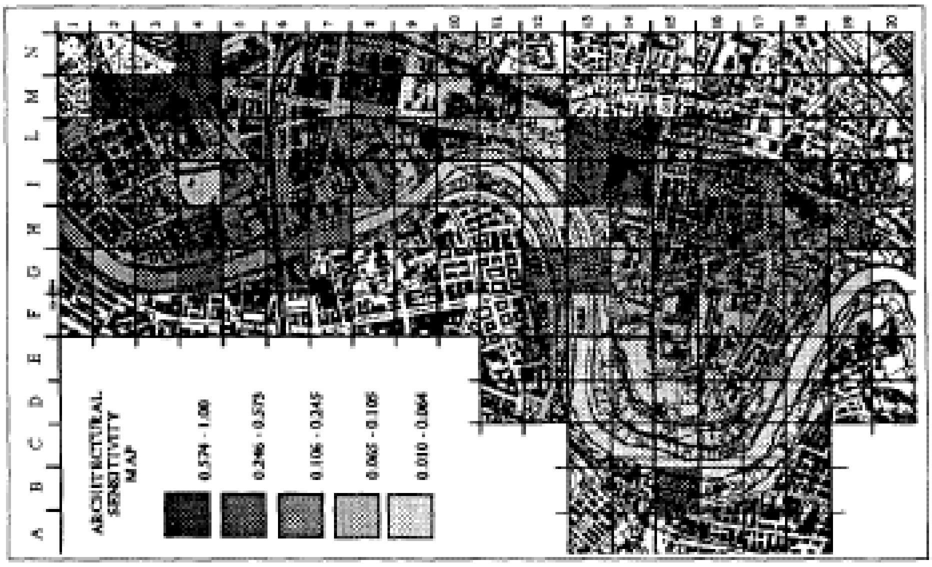


Fig. 6b: architectural sensitivity map.

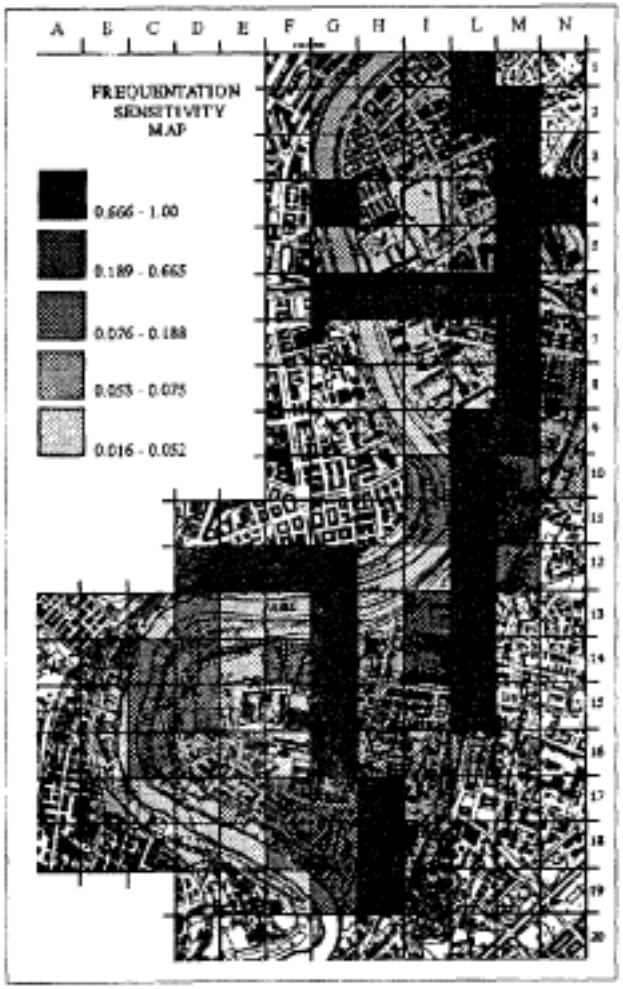


Fig. 6c: frequentation sensitivity map.

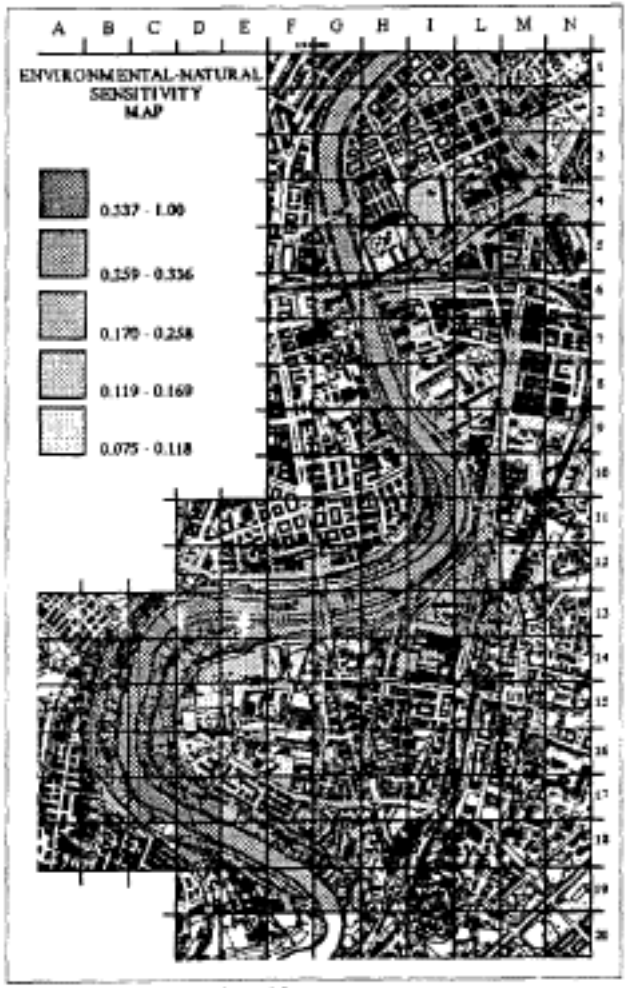


Fig. 6d: environmental-natural sensitivity map.

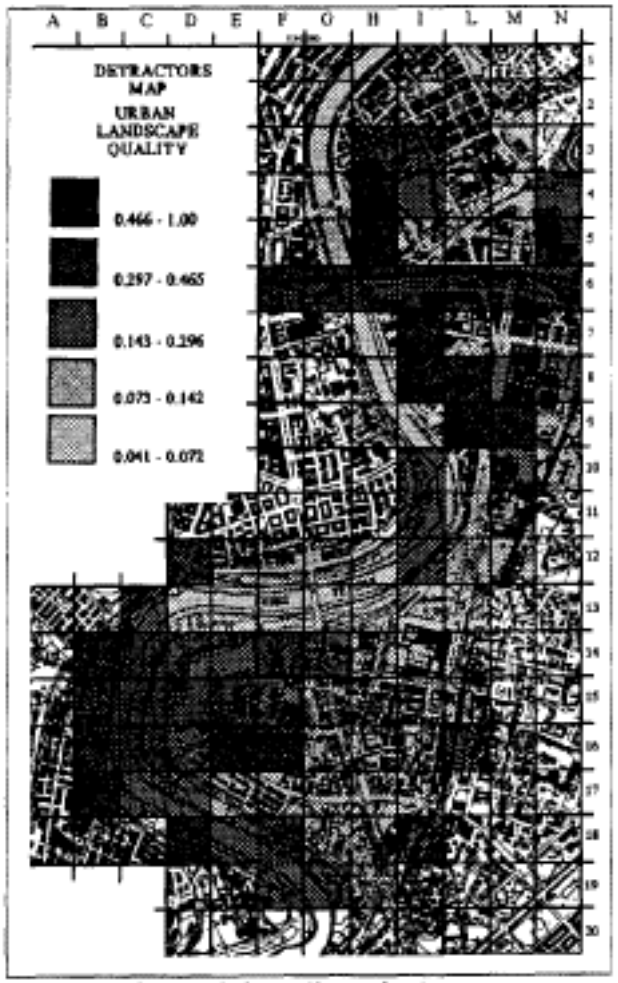


Fig. 6c: Urban landscape sensitivity map. (detractor factor)

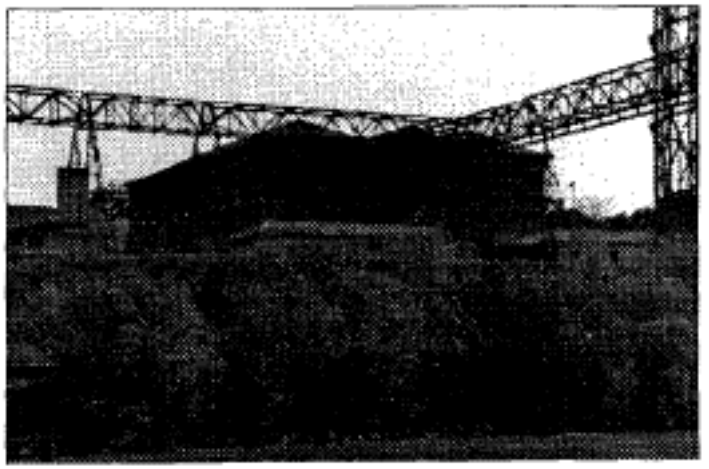


Fig. 7a: the "magazzini generali"

Fig. 7b: view of the ex industrial area Ostiense in Rome.

Fig. 7c: the "gazometro" and the "ponte dell'industria".