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Guidelines for Best Practice in User Interface for GIS

Section 5
"Checklist for selecting and defining user requirements for specific GIS applications"

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5. Checklist for selecting and defining user requirements for specific GIS applications

This section introduces a checklist for driving the end user in requirement collection for a specific GIS application. The granularity of the checklist, that is, the degree of detail of its points, has been chosen having in mind two contrasting objectives: completeness and applicability. The former objective has been pursued by splitting the requirement collection into general (steady) aspects and other (evolving) aspects related to single application fields. The latter takes advantage of the checklist organisation into homogeneous modules that should focus user attention on clear and distinct subjects.

The section is subdivided into three sections. The first section justifies the need for such a checklist and explains how the underlying requirement collection criteria have been identified and validated. The second section gives brief indications on how the checklist should be used effectively by the end user and what the expected result is after its application. Finally, the third section proposes the checklist in terms of seven general modules (Project organisation, Project outcome, Map acquisition, Derivation process, User interface, Map visualisation, Database organisation) and two application-oriented modules (Environment Control, Urban Planning).

5.1 Task rationale and procedure for criteria identification

It is widely recognised that end users find it difficult to clearly define what their requirements are when facing the development of a new GIS project. As domain experts they usually know quite well what the project is aimed at, but the distance existing between their culture and lexicon with that of the adopted GIS technology still constitutes a huge obstacle. The solution most commonly pursued is informally transferring these requirements to a GIS technology expert, relying on his/her ability to understand (and possibly complete) the representation of the project objectives.

Requirements specification with the guidance of this checklist if communicated to the developers is the beginning of a full user-centred application development.

5.1.1 The user requirements checklist

The near future will probably see the definition of proper requirements representation models conceived for a direct use by the end user, and proper GIS-Office technologies that will put the end user in a position to operate alone on the geographic database to select maps and derive new territory representations. However, much can already be done starting from the current practice by taking advantage of the experience gained in many different GIS projects.

We consider a significant step forward the possibility, for the user, to collect alone his/her own requirements. This knowledge can be used as a basis for the preparation of good bid requests and contracts with the candidate application developers, and as a guide for the systematic control of the project intermediate and final results. A very simple and familiar mean to help the user in this task is providing him/her with a checklist that recalls all the main requirement collection aspects. In fact, one of the most important issues of requirement collection is completeness in both functional and nonfunctional terms. Then, the checklist helps the user to not forget significant aspects and to structure the collected requirements so as to favour comparison, verification and (possibly) the reuse of previous documentation.

In order to understand which are the requirements that allow the user to represent his/her needs and objectives, it is useful to consider the view the user has of the GIS application. In general the user is neither interested in, nor informed of what happens inside the GIS platform; rather he/she tends to keep thinking in terms of the concepts and objects that are familiar in his/her world: maps, symbols, scales, drawings. The image the user has of a GIS application is

exactly that resulting from the application interface which, in some sense, plays the role of a ”window” on the underlying GIS system. In other words, all what happens on the interface is a matter of requirement specification, the rest being necessarily left to developer experience.

The second consideration to take into account in defining the user requirements checklist refers to the fact that, typically, a GIS application is aimed at deriving information (usually a new map) from the data available in the geographical database. When facing a new project the user traditionally describes to the application developer the characteristics of the map to be derived and the sequence of operations to be performed on the available data in order to achieve such a result. In short, user mental model is strongly focused on the idea of the derivation process, hence the application cannot but adapt to, and possibly reinforce, it. The checklist itself, in particular the part concerning the functional requirements, must be defined clearly in this respect.

5.1.2 The procedure for criteria identification

The end user has a deep knowledge of the application domain and of the problem to be solved, but normally s/he is not used to expressing in some structured and disciplined way his/her requirements. This difficulty is due to at least two reasons: (i) every GIS project takes years to be carried out, thus the user is seldom involved in requirement specification; (ii) analysis techniques constitute a rather specialised competence, which is difficult to acquire and normally known only to the application developer.

In turn, the application developer is interested in collecting and interpreting the user needs with the aim of identifying the most convenient solution to them. Convenience means, in GIS projects, limit the very high costs of data collection and deliver a minimal set of functions in the shortest possible time. This habit is not negative in itself as it tries to meet the user needs in reasonable economical conditions: unfortunately, it can lead to misunderstandings and, ultimately, to the well-known and very diffused user dissatisfaction.

For these reasons we consider it unlikely that the user alone or the application developer alone are able to propose a valuable and complete checklist. The user’s important contribution should be concentrated on the indication of requirements for single GIS projects and on the final checklist validation and improvement activity. Similarly, the application developer’s contribution is mainly focused on providing practice knowledge from which a project (and hence an interface) design best practice can be drawn. A further contribution comes, in this case, from those organisations that play the role of intermediary user, as they represent the interests of user groups with respect to technology providers and application developers.

The BEST-GIS Consortium includes representatives of all these categories, which joined their efforts and skills to draw a general and flexible checklist. The procedure followed in the identification of the requirement specification criteria was based on four main steps:

1. A tentative checklist was prepared as a synthesis of experiences and practices identified within the Consortium, and taking advantage of the study of some particularly interesting application projects.
2. The checklist was submitted to users within and outside the BEST-GIS consortium for validation, i.e. applying it to the collection of requirements of ongoing and new projects.
3. The checklist below is an improved version based on the validation results.
4. The checklist has now been disseminated to collect further comments from a wider audience which can lead to its periodic improvement, extension and possible specialisation by type of application field.

5.2 How to use the checklist

Collecting and specifying the requirements for a GIS application is a difficult and critical work, especially for the end user. The difficulty mainly arises from the need to explicitly determine all the aspects and constraints that can have an impact on the application design and development. The criticism arises from the fact that incompleteness and possible ambiguities have a negative effect on the following phases of the application development cycle and introduce misunderstandings that require much effort in order to be removed. For these reasons, and for the role that requirements play in the definition of a new project, particular care must be spent in their collection and compilation.

In this section we give brief indications on how the checklist should be used effectively by the end user and what the expected result is after its application.

5.2.1 Requirements specification (RS)

Generally speaking, requirements are intended as a description of the user problems which GIS application must solve and the constraints the solution must satisfy. In order to understand their role it is useful to remember that the requirements specification (RS) phase precedes the design and development phases in the application development cycle. Thus, it enables the developer to fully understand the overall nature and the specifics of the application, and also acts as an opening for the establishment of adequate user contacts throughout the remaining phases of the cycle.

In particular, for very complex and innovative systems (as GIS applications are) a full RS is needed as a basis for feasibility estimation in order to reduce contractual risks. It means that the RS document is fundamental in establishing a correct and unambiguous contract with the developer organisation where all the significant aspects are clarified and evaluated in their development cost and time. Besides, it is vital that the specified requirements be verified at the end of the development cycle and during testing. This document is valuable throughout the whole project as it is a clear and complete statement of the required functionality for the intended application, jointly prepared and agreed upon by both the user and the involved developer.

The application requirements represent the conversion of broad-based user needs into a working specification document upon which development effort can be focused. The RS output should present all the functional and non-functional system requirements (or, at least, those identified at this early stage) and indicate design and implementation directives of the intended application:

- Functional requirements display the functionality of the application. It means making explicit the actions and operations which the application must provide to the user, and the data types to which these functions are applied.
- Non-functional requirements tend to be constraints that the completed system must fulfil. In addition to performance issues (e.g.: response time, data volume, execution frequency) they include indications on user role, application audience, data accessibility.
- Design directives are user constraints upon the structure of the system solution and could detail hardware selection, data storage and transfer methods such as communication protocols. Implementation directives constrain the developer by defining choice of implementation language or database management system.

While the checklist proposed in this section deals with the first two points, design and implementation directives are considered in sections 6 and 7 of these Guidelines.

An important aspect to consider when compiling an RS document is the form that this document should take. Most of the RS models proposed in the literature are informal, in that

they simply suggest a reasonable organisation of the RS document into chapters and sections without defining a formal syntax to fill it. One reason is that, at the specification time, many aspects are still open or not completely decided: the RS document must be complete but it remains independent of implementation issues. Another reason is that a formal RS language could hardly be employed by the end user and this would limit its role and autonomy. Finally, the RS phase cannot consume too much effort as it consists in a preliminary phase of a development cycle that could terminate at the feasibility stage.

5.2.2 Checklist application

Preparing the RS document means collecting and synthesising the viewpoints of the different identified application users. In fact, because of its high cost, only a long life cycle and the benefits it can bring to a number of users justify a GIS application. Each of these users tends to have his/her own focus on the functions the application will make available: taking into account all of them is a necessary condition to create a useful application. We see two alternative ways of using the proposed checklist to derive the synthesis requirements:

- Every user collects and specifies his/her own requirements by following the checklist alone (obviously, not all the users will consider all the points of the checklist). Then, the resulting documents must be discussed and unified into the final RS document. This requires meetings on the different sections, with the participation of interested users and, possibly, the application developer. The main advantage of this approach is the total freedom of the single user in expressing his/her viewpoint and, hence, the completeness of the final document. The main drawback is the redundancy of the specification work as many users may give the same indications on many points.
- Users organise meetings for the different sections of the checklist with the purpose of discussing requirements point by point. The outcome of this work is directly the final RS document. A first important by-product of this approach is a very early constitution of a working group where all members are aware of the common interest and objectives. Besides, convergence on a single point is likely to be reached faster than with the previous approach. The drawback is that some users tend to become meeting leaders and impose their viewpoints.

Going through the checklist sections, it is worth taking into account the following suggestions for a good use of the checklist itself:

0. ***General requirements.*** This section recalls some general requirements that are applicable to different projects and especially to software based projects. The requirements listed in this section are general, and the accomplishment of each of them may depend on different items among those which are listed in subsections 1 - 8.

1. ***Project organisation requirements*****.** When compiling this section, the user must keep in mind that a success key in every project is stating clearly, from the beginning the purpose and scope of the intended initiative. In fact, many problems (high cost, long delivery time, insufficient or overspent resources, changes with work in progress, conflicts with the developer) often arise from starting a project whose content boundaries are not well understood. Another aspect that is worth capturing is the user roles and the management responsibilities along the project. This is necessary to avoid user participation only in the early and final phases of the development cycle, and also to avoid vague developer identification of his/her counterparts.

2. ***Project outcome requirements*****.** As the project is usually aimed at producing maps, characterising the project outcome is a very important issue. It is well known that starting

from outcome description makes it easier to describe all the other aspects of an application (input data, computation process): this is the reason why we put this section first. Another justification of the importance we assign to this section is that project feasibility is better carried out by comparing the benefits expected from the project outcome (and the desired due time) with the cost of its production (and the planned delivery time). This also holds for those cases when the project result is not a map but, for instance, an analysis or simulation package.

3. ***Map acquisition requirements*.** Once the project outcome has been described completely the user has all the elements for understanding what the input data are for the application he/she will use. In general, only some of them are already available in the user organisation databases, hence a specific acquisition activity is often required. We suggest paying much attention to this aspect since the acquisition of geographical data is a very time and resource consuming task. Planning an application which relies on the acquisition of many new data introduces risk elements that must be carefully evaluated. A better approach consists in distinguishing the data to be fully acquired from those that can be imported from other organisations or obtained by adaptation and completion. This checklist section includes points that help the user in taking into account this possibility, and also suggests considering volume and cost issues.

4. ***Derivation process requirements*.** Most GIS applications are aimed at studying and comparing territory properties, that is, deriving new maps from those already available. After having described the expected outcome and the input maps (that represent the analysed territory properties) the derivation process is illustrated. This is, more than others, an end user task (intended as the application domain expert) since he/she is the only one in condition to say how the input data contribute to the construction of the project result. In fact, the derivation process should be the exact image of the idea the user has of the problem to be solved with the intended application. We suggest answering this checklist section by preparing very clear and detailed information, that is, a precise representation of the functions to perform on the input data. This requires, compared to the other sections, a higher degree of formalization in describing the functions to be executed at every derivation step. For this reason we propose that a catalogue be made available to the user which contains the description of common or already developed functions(see section 6 and 7).

5. ***User interface requirements*.** Many requirements on the possibilities the application interface should offer to the user are collected according to points of the other checklist sections. In fact it is worth remembering that the application interface corresponds, for the user, to the way the application is thought of. Here we invite the user to focus again on the interface to make explicit aspects that might have been neglected, so as to avoid their specification while the development work is in progress. Aspects that require particular attention are help and navigation capabilities, as well as protection against user errors or unauthorised accesses. We suggest that this section be compiled in collaboration with the developer, as it deals with technical issues.

6. ***Map visualisation requirements*.** A distinctive aspect of GIS applications is the role that map rendering has for the users. The user is in charge of the complete definition of map visualisations (size, colours, fonts, symbols, legends and the like) with respect to every rendering means. We suggest considering the three main means available today, namely workstation display, paper (through different plotting technologies) and the Internet. Although the user is the only one in a condition to decide upon the aspect of visualised maps,

important help can come from having proper look-up tables available or, as an alternative, by collaborating with the application developer.

7. ***Database organisation requirements*.** Geographical data have usually associated attribute (quantitative, descriptive) data. This means that the GIS application is provided with both a graphics database and an attribute database. While the application developer derives the content of the former from requirements concerning project outcome, inputs and derivation process, the latter needs further specifications. With this section we aim at driving the user to consider which attribute data are useful, which are available and to which territory entities they are associated. We suggest the user describe the application attribute data by means of a simple and semi-formal conceptual model, possibly with the aid of the developer.

8. ***Specific application requirements*.** The two last sections are aimed at proposing further points that are specific in a certain application context. After the user has compiled the previous sections in all their aspects, he/she can consider the application section of specific interest. Here he/she can find hints on needs and functions that are peculiar in such field: they are derived from previous experiences and hence can be enriched every time the checklist is used. The richer these sections become, the more effective their use in capturing exhaustive requirements.

5.3 Checklist of functional and nonfunctional requirements

The following checklist is proposed as a guide to drive the end user in collecting and expressing the requirements of a new GIS application project. In fact, going through the checklist the user has the opportunity of ascertaining whether the comprehension he/she has of the application is sufficiently clear and whether the collected requirements are complete and properly organised. In other terms, compiling this checklist means building up the documentation which is recalled by each of the identified points.

At the time of its delivery the checklist corresponds to the knowledge, on the project development process, that has been found within the BEST-GIS Consortium. Validation of the checklist showed that the degree of completeness of this checklist is indeed rather high, the most important aspects on which a GIS project relies are taken into account. Nevertheless, further points can be conveniently added as soon as they are considered capable of capturing other aspects here neglected or collapsed.

An interesting direction to follow in making this checklist more and more effective is that of its specialisation by type of application field. As shown in the last two sections, devoted respectively to Environment Control and Urban Planning, it is useful to integrate the general aspects with application-oriented points. These are mainly focused on recalling user needs that have often been met in concluded and ongoing projects of the single application type. These sections can hence increase in number and richness of points and thus constitute the principal evolution path for the checklist itself.

5.3.1 General requirements

This section concerns the specification of some general requirements aimed at satisfying fundamental user needs. These requirements have to be accomplished not only in GIS projects, but in almost any type of software based project. For each considered item a short description is provided. These general requirements have to be considered as a general reference framework when addressing more specific requirements listed in subsection 5.3.2 to 5.3.10.

0.1	Are the level of the detail and the accuracy of the work defined ?	
0.2	Are the necessary speed of access and manipulation defined ?	
0.3	Is the complexity of task under control?	
0.4	Is the size of involved data under control ?	
0.5	Are security requirements defined ?	
0.6	Are reliability requirements defined ?	
0.7	Is the use of legacy systems identified ?	

5.3.2 Project organisation requirements

This section concerns the specification of requirements relative to the project intended as a whole and its organisation and control. In particular, it is aimed at pushing the user to explicitly describe project aspects that are often neglected or left to the initiative of the application developer. Because of the general view it suggests, this section essentially refers to non-functional requirements.

1.1	Are the GIS project overall objectives and results clearly understood and explicitly expressed?	
1.2	Are the parties interested in the GIS project identified and the expected use of the project results described?	
1.3	Are general rules fixed to regulate the accessibility of the GIS project audience to the project results?	
1.4	Are the GIS project financial, temporal and other constraints clearly understood and explicitly expressed?	
1.5	Are the GIS project stakeholders identified with their respective decisional role and priority?	
1.6	Has the user organisation nominated a manager for the GIS project, who is responsible for the relations with stakeholders and the application developer?	
1.7	Is the GIS project workplan formally established with indication of the main phases, precedence, milestones and checkpoints?	
1.8	Are evaluations of the GIS project progress planned and the responsible person for conformity verification and replanning identified?	
1.9	Are installation procedures and acceptance tests explicitly established and included in the GIS project contract?	

5.3.3 Project outcome requirements

This section is intended to be replicated for every single result (typically, a derived map) expected from the GIS project execution. Main aspects are the explicit definition of the output map itself, the associated descriptive and quantitative information and the representation of possible constraints on its use and diffusion.

2.1	Is the output map properly described in terms of its meaning and expected use, and unambiguously characterised by its component layers?	
2.2	How critical is this product in terms of calculation frequency and (human and computer) resource occupation, with respect to the other project outcomes?	
2.3	Are the desired map features (scale, tiles, accuracy, quality, topographical constraints, etc.) expressed?	
2.4	Are the envisaged accesses to the output map (open, export, etc.) and to the single layer coded so as to make the developer realise the corresponding interface commands?	
2.5	For each layer, is the relative content clearly described and its graphic representation (points, lines, etc.) correctly determined?	
2.6	For each layer, are the associated descriptive and quantitative data identified and declared?	
2.7	For each layer, is a default presentation (colours, symbols, data, etc.) decided so as to make the developer realise the corresponding interface commands? *(*)*	
2.8	Is the set of the input maps used to derive the output map in discourse clearly identified and explicitly declared?	

(*) The user could be facilitated by having proper look-up tables available for the selection of the most suitable colours, styles, symbols and other effects. The tables should be progressively extended with the introduction of new options decided by the user.

5.3.4 Map acquisition requirements

This section expresses the requirements on how to obtain the basic maps that constitute the input to the GIS project. The following points must be replicated for every single map expected from the execution of the GIS project. Generally speaking, they can be already available in some databases, or be imported from other organisations, or even be acquired from a finalised territory survey. A complete identification of the input maps is fundamental in planning the application development work.

3.1	Is the input map properly described in terms of its meaning and unambiguously characterised by its component layers?	
3.2	Are the envisaged accesses to the input map (open, import, etc.) and to the single layer coded so as to make the developer realise the corresponding interface commands?	
3.3	For each layer, is the relative content clearly described and its graphic representation (points, lines, etc.) known?	
3.4	For each layer, are the associated descriptive and quantitative data identified and declared?	
3.5	For each layer, is a default presentation (colours, symbols, data, etc.) decided so as to make the developer realise the corresponding interface commands? *(*)*	

3.6	Is the input map source (local or remote database, adaptation of an existing map, import from another organisation, result of on-field survey, etc.) recognised?	
3.7	In case of adaptation, is the required preparatory transformation or completion activity described?	
3.8	In case of import, is a format or other conversion required and, if any, is it clearly described?	
3.9	In case of a survey, are the survey aims focused, the data to collect identified, and the digitisation criteria specified?	
3.10	Is the size of the map to be acquired clearly understood and the acquisition or adaptation cost evaluated?	

(*) The user could be facilitated by having proper look-up tables available for the selection of the most suitable colours, styles, symbols and other effects. The tables should be progressively extended with the introduction of new options decided by the user.

5.3.5 Derivation process requirements

This section is aimed at stimulating the end user to express his/her own idea on how each GIS project outcome can be obtained from the input maps. This information should be replicated for every output map, although some phases can be common to more derivation processes. The sequence of operations and transformations is split into elementary steps and each of these must be described in terms of the input data, output data and operation performed. In particular, the operation description is very critical as it impacts on software development.

4.1	Is the derivation process unambiguously described in terms of steps, each of which can be represented separately from the others?	
4.2	How critical is this derivation process and each of its steps in terms of execution frequency and (human and computer) resource occupation, with respect to the other project processes?	
4.3	Is the process univocally denoted, and its representation and management functions (do, undo, redo, etc.) explicitly requested, so as to make the developer realise the corresponding interface commands?	
4.4	For each step, are its input and output data identified, denoted and characterised in graphical and descriptive terms?	
4.5	For each step, is the transformation or derivation operation described in detail, possibly taking advantage of an operation catalogue? *(*)*	
4.6	Is the set of step input data, output data and operations properly classified so as to make the developer realise the interface commands to access and activate them?	
4.7	Is a test and validation plan established to perform an early conformity control of the operations as they are realised by the application developer?	

(*) Having available a catalogue where the most common operations are already characterised makes this task much simpler. The user can identify the operation of interest within the catalogue, or describe it as a specialisation or a variant of an existing operation, or add a new operation whenever it must be defined from scratch.

5.3.6 User interface requirements

This section concerns the specification of requirements relative to the final user interface. The user interface defines the way to access geographical data. Customisation of interface windows, menus, buttons, and the like plays an important role for the usability of the system, defining the basic interactions with data. Moreover, the user interface provides navigation capabilities so that he/she may find the needed information. Hereafter the term view indicates a complete interface item or window possibly with its map, menu, buttons, icons, tool bars and others. A complete interface consists of multiple views connected by a set of (logical) links which provide one or more navigation paths.

5.1	Is the overall design of the user interface, views, navigation paths and links, clearly defined by the application developer in a form suitable for user evaluation?	
5.2	Is an analysis of the proposed interface carried out to ensure that it provides an efficient navigation to limit the number of steps necessary to get to the searched data/map?	
5.3	Is the design of each interface view properly defined to provide a clear and efficient access to a consistent piece of information?	
5.4	Does the interface design provide suitable help and is it simple enough to make the beginners able to operate with its major features without using manuals?	
5.5	Is the interface efficient enough to avoid tedious and time-consuming interactions for the experienced, smart user?	
5.6	Does the interface protect data against input errors, and provide help to check input validity?	
5.7	Does the interface protect data against unauthorised accesses?	
5.8	Are the characteristics of the overall environment (single application, centralised or distributed control) taken into account by the interface design?	

5.3.7 Map visualisation requirements

This section collects the requirements on the desired aspect of map rendering. The following points apply to every single rendered map, no matter if it is an input datum, an output datum, an intermediate datum or any combination of them. At least three different representation media should be considered: display, paper and the Internet. Indications on the aspect that every map and its single layers will take on the alternative media, and the definition of possible freedom degrees for the user in deciding the rendering form, are taken into account.

6.1	Is map visualisation clearly and fully described in general terms (scale, style, legend, etc.)? *(*)*	
6.2	For each layer, is the desired rendering (colours, symbols, data, etc.) decided so as to make the developer realise the corresponding interface commands? *(*)*	
6.3	Are the relations between layer visualisations within the map (overlapping, transparency, and other effects) made explicit? *(*)*	
6.4	For each display map, are the required interactive graphical functions (zooming, highlighting, changes in colour and other aspects, etc.) decided so as to make the developer realise the corresponding interface commands? *(*)*	

6.5	For each paper map, is the resulting sheet quality (size, type of paper, type of plotter, etc.) classified so as to make the developer realise the corresponding interface commands? *(*)*	
6.6	For each Internet map, is the simplified aspect of the resulting map, and the possible links to other data, decided so as to make the developer realise the corresponding interface commands? *(*)*	

(*) The user could be facilitated by having proper look-up tables available for the selection of the most suitable colours, styles, symbols and other effects. The tables should be progressively extended with the introduction of new options decided by the user.

5.3.8 Database organisation requirements

This section is intended to provide help in evaluating the requirements for databases associated to a GIS project. The database main goal is here to hold information that cannot be adequately represented in a graphical manner, and to provide an alphanumeric integration of graphical information. In any case, most data contained in the database are normally geo-referenced. Hereafter we use the term attribute data to indicate data contained in the database.

7.1	Are the meaning and function of attribute data clearly specified?	
7.2	Are the sources of attribute data clearly identified and the procedures for data update defined?	
7.3	Is the correspondence between geo-elements and classes of attribute data clearly established?	
7.4	Are the relationships between attribute data expressed at the conceptual level?	
7.5	Are data import/export problems clearly identified and addressed?	
7.6	Are the volumes of attribute data understood and the acquisition cost evaluated?	

5.3.9 Environment Control requirements

This section represents an example of specialised points with respect to the single application context. While general-purpose requirements are collected with the previous sections, here the focus is on content and method issues that are typical of the considered context. A progressive extension of this section is expected by those organisations that have acquired experience in the Environment Control field.

8.1	Are the features of the required Digital Terrain Model (DTM) clearly understood so as to drive the developer in choosing the right model?	
8.2	Does the application require visibility analysis (i.e. determination of the territory extent visible from a given point) by using a DTM?	
8.3	Does the application require hydrological flow analysis (i.e. determination of water flow paths) by using a DTM and a fluid pressure model or ground water model?	
8.4	Does the application require real time hydraulic simulation (i.e. simulation for flood management, simulation for surface pollution propagation)?	
8.5	In general, which kind of integration is expected between the GIS system and external packages for environmental modelling?	
8.6	Does the application require the loading of external data sets coming from environmental monitoring (e.g. on line acquisition, real time information from sensors)?	

8.7	Does the application require the combination of raster images with vector maps?	
8.8	Does the application require the support to raster analysis functions (e.g. analysis of satellite images)?	

5.3.10 Urban Planning requirements

This section represents an example of specialised points with respect to the single application context. While general-purpose requirements are collected with the previous sections, here the focus is on content and method issues that are typical of the considered context. A progressive extension of this section is expected by those organisations that have acquired experience in the Urban Planning field.

9.1	Does the application require the integration of the different levels of Urban Planning committed to different decision levels?	
9.2	How should data and information sharing among the different users be managed?	
9.3	Do any functions of this application need to be accessible to users not skilled in GIS technology (e.g. decision-makers)?	
9.4	Does the application require reading CAD formats directly, without importing them (as urban planners may have large heritage of CAD maps)?	
9.5	Does the application require calculating parallel buffers to street centre lines, so as to determine affectation to private land?	
9.6	Does the application require simulation functions (e.g. for evaluating future scenarios according to hypothesised development models or planned decisions)?	
9.7	Does the application require performing network analysis with real time data (e.g. traffic analysis, traffic lights management)?	
9.8	Does the application require performing dynamic segmentation?	
9.9	Does the application require performing ”roving window” neighbourhood analysis?	

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